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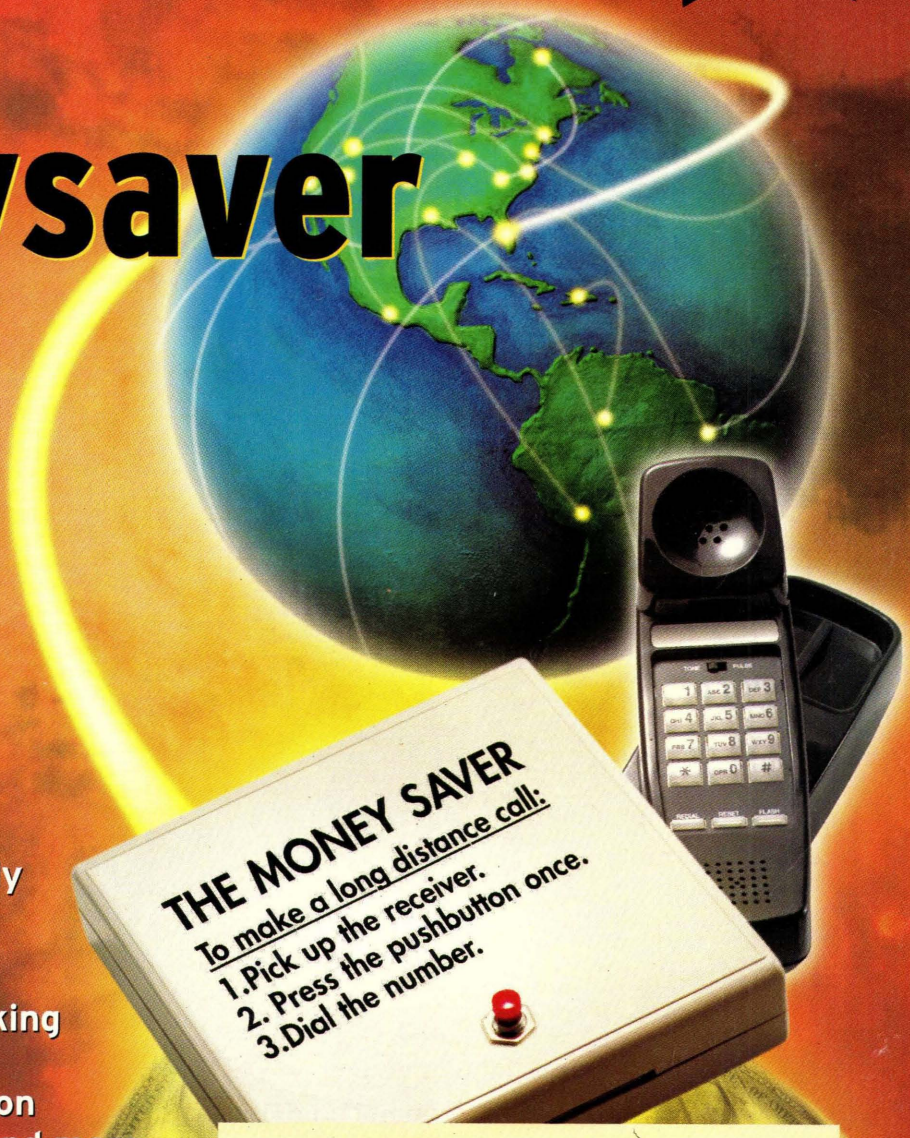

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The millennium is upon us. The year 2000 is right around the corner. What will it bring?
—***Poptronics*** – *the magazine for the hands-on electronics activist!*

Today's challenging electronics marketplace does not leave room for a variety of competitive publications aimed at the hands-on kind of electronics activist — the professionals who design, build, maintain, and repair all of the electronics gear that fills our lives, the experimenters who build projects, the computer enthusiasts who want to know what's in the latest gear, the activists who want to and are building robots, audiophiles who want to test new circuits and designs, ham-radio operators looking for what's out there to communicate with.

That's why Gernsback Publications has melded our two publications – *Popular Electronics* and *Electronics Now*, into this new, exciting and timely monthly magazine – ***Poptronics*** – that you now hold in your hands. Coincidentally it is the January 2000 issue. What a way to enter the new millennium! (Yes I know the millennium actually starts January 1, 2001.)

It's evolution! ***Poptronics*** is here! No matter what your specific interest in electronics; ***Poptronics*** is the magazine for all electronics activists in the 21st Century. We've been here since the beginning, when back in April 1908 we published the first issue of *Modern Electrics.* We're still going to be here for the start of the next millennium, the year 3001, with ***Poptronics*** or its future descendant.

We have brought all of the very best elements of our existing magazines into ***Poptronics.*** It is designed to deliver to you, our readers, the very best editorial variety we can assemble. We have packaged *Gizmo, Prototype, Hands-on Reports, Service Clinic, Peak Computing, Robotics Workshop, Amazing Science and other key columns*; and wrapped them around a main editorial package of construction projects, product lab reviews, how it works and how to do it articles, to create a wonderful new world of electronics for the new millennium!

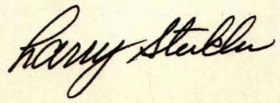
Our web site at www.gernsback.com will still be there too. The forums, searchable index, and links will stay as they are, but you will find a lot of "under construction" signs in other areas. Keep logging in to keep up with what is happening. I believe that you will find our web site even more useful than before. We will continue the forums that bring thousands of readers to exchange ideas, get questions answered, and find the latest updates on contents in the magazine. It's a great place to search the index for old articles and to download current articles and artwork from the current issue.

If you are a current subscriber to *Popular Electronics*, you will automatically receive upcoming issues of ***Poptronics*** (starting with this January 2000 issue) until your current subscription is fulfilled. If you also subscribe to *Electronics Now* we will combine your subscriptions (if you have 10 more issues of *Popular Electronics* to go, and 5 issues of *Electronics Now* – for example – you will receive the next 15 issues of ***Poptronics***).

If we goof and you get two copies of ***Poptronics*** this month, just cut off or copy the labels on the front cover of both magazines and send them to me. I'll see that your subscription is merged without you losing a single copy.

An exciting new world of electronics publishing begins with this January 2000 issue of ***Poptronics***. Be our partner in progress. Stay with us and see just how great our electronics industry can be. We will continue to bring you all of the latest electronics news as fast as it happens.

Larry Steckler, EHF,CET
Publisher



Electronics Now
February 2000, Vol. 1, No. 2
Popular Electronics®

Poptronics®

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

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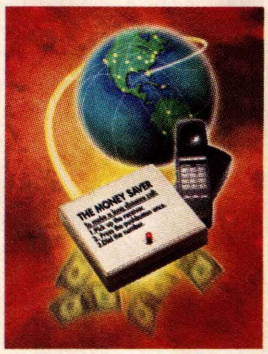

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Editorial

New Ways to Reach Out

Remember when it was almost taboo to make a long-distance phone call? You'd visit a friend's house and ask to use the phone; and, no matter how polite your pal might have been, a question would be asked:

"Is it a local call?"

And it was a valid concern. Long-distance calls—even to numbers in the same state but not the same area code—could run several dollars for a typical ten-minute chat. Fortunately, there are now ways around such exorbitant charges. Notice all those commercials for discount, long-distance access codes (10-10 this, 10-10 that, and so on)? We hope so, as many of these services can save you big money. However, some have hidden fees that you only learn about when your next phone bill arrives....

From now on, protect yourself from dialing those long-distance codes that cheated you and stick to those that provide the best savings. We found a way to dial your favorite code with the push of a button—we call it the *Moneysaver*, and you can learn how to build one by turning to page 15.

For a more innovative way to save on long distance—even get it for free, depending on the hardware your call recipient owns—consider using Voice over Internet Protocol (VoIP) technology. A new generation of Net telephony products and services is available, providing cell-phone quality or better. Explore the exciting world of VoIP, starting on page 43.

Also, in keeping with this month's theme, we've included a couple of our favorite telephone gadgets to help you make the most of this wired age.

Our *Hold and Line In-Use Project* enables you to put callers on hold. More important, it warns you when someone's on the line or warns others when you're online, thereby preventing an aggravating Internet disconnect. Check it out on page 21.

Readers with more than one piece of equipment hooked up to a line should consider the phone company's Distinctive Ring feature. With this service and the *Call Director*, you can route incoming calls to fax machines, computer modems, numerous answering machines, and, yes, even specific phones. Page 24 will fill you in on all the possibilities.

We also hope you enjoy the eclectic blend of our regular columns and departments. Are they all you expect? Are we providing the most complete coverage of hands-on electronics around? Please let us hear from you. While we haven't been running a "Letters" column yet (because the first issue of this magazine hasn't hit the stands as I write these words), we do look forward to your comments on the new title. **Poptronics** is the electronics activist's magazine, your magazine, and your input is given priority consideration. So get writing!

Konstantinos Karagiannis
Editor

Poptronics

Larry Steckler, EHF, CET, editor-in-chief and publisher

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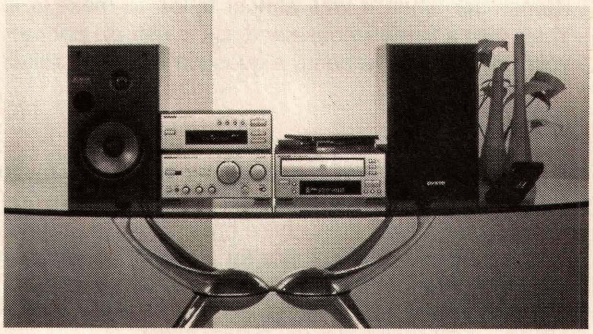

The newest Executive Series bookshelf audio system from Onkyo USA Corporation is the model *LS-2050* ($799.95), which adheres to the fashionably understated, space-saving design principles of its predecessors: simplicity and sonic accuracy before flash and features. To that end, the system includes three separate, extremely compact yet high-performance components—an integrated amplifier, an AM/FM tuner, and a three-disc CD changer—along with a pair of speakers. The vented, two-way speakers are said to provide powerful and extended bass with open, accurate midrange balance, and excellent treble transparency.

The A-905X amp uses Onkyo's all-discrete-output wide-range amplifier technology to provide 22 watts per channel into 4 ohms (0.05% THD). The amplifier provides a subwoofer pre-out, an ultra-pure Source-Direct listening mode, and a six-channel audio input to handle potential system expansion. The C-707CH CD changer allows you to change two discs while the third is playing. Optical and coaxial digital outputs assure compatibility with MiniDisc or CD recorders or other digital audio equipment. The T-405X tuner offers quartz-synthesized tuning accuracy and the convenience of 30 station presets, station-naming capability, and a four-mode weekly timer.

Onkyo USA Corporation, 200 Williams Drive, Ramsey, NJ 07446; 201-825-7950.

CIRCLE 50 ON FREE INFORMATION CARD

Senior-Friendly VCR

Thanks to its well-organized manual, which pairs the text with pictures of corresponding onscreen menus, and that onscreen menu system itself, the *RCA VR646HF VCR* ($299) from Thomson Consumer Electronics, has earned the seal of approval from Senior Friendly, an organization that searches for consumer-electronic products that are technologically advanced, yet easy to use.

The four-head, hi-fi VCR offers convenience features including Commercial Advance, Movie Advance, and VCR Plus+. After a television program is recorded, the Commercial Advance system locates and marks the commercial segments. During playback, the VCR automatically fast-forwards through the marked portions, reducing three minutes of commercial time to 10 seconds in SLP mode. Movie Advance automatically finds the beginning of the movie on most pre-recorded VHS tapes, then pauses the tape and informs you that the movie is about to begin. It also allows you to selectively view the previews, skipping from one to the next. The VCR Plus+ system simplifies programming by allowing you to enter a show's PlusCode programming number, which can be found in *TV Guide* and most newspaper TV listings.

The VR646HF comes with a backlit universal remote control and provides multi-brand satellite-system/cable-box control.

Thomson Consumer Electronics, 10330 North Meridian Street, Indianapolis, IN 46290; *www.rca.com.*

CIRCLE 51 ON FREE INFORMATION CARD

On a Pedestal

For those who prefer to keep their audio equipment on display, Bell'Oggetti International offers the *SP-200* speaker stands ($200/pair). Attractively styled in basic black with a contemporary flair, the stands feature a bowed front piece that spans the three-foot distance from base to pedestal. The 7-inch-square top plate is equipped with rubber strips to securely hold in place a speaker weighing up to 100 pounds.

Behind the curved front piece is a hollow tube that not only supports the top piece, but also serves as part of Bell'Oggetti's Cable Management System. Speaker wires can be routed through the tube, completely out of sight, for a clean, uncluttered look.

Bell'Oggetti International, 711 Ginesi Drive, Morganville, NJ 07751-1250; 732-972-1333; *www.belloggetti.com.*

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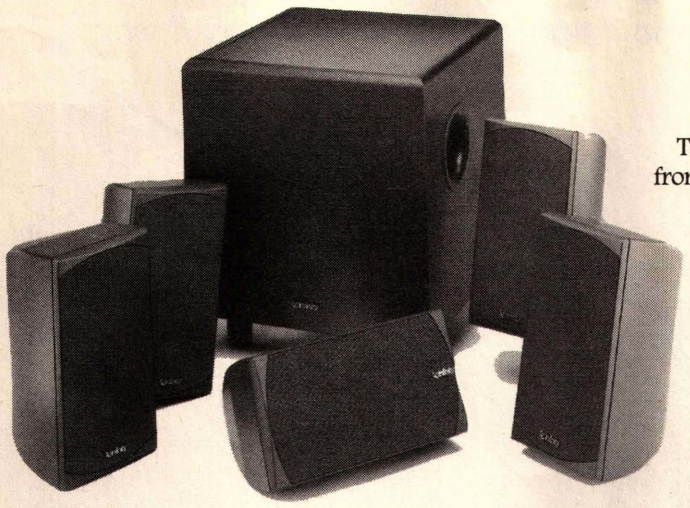
Big Sound, Small Package



The *HTS-10 Home Theater Loudspeaker System* ($749) from Infinity Systems, Inc. is designed to meet the demands of today's Dolby Digital 5.1-channel soundtracks, which require each of the five main channels to reproduce a wide frequency range. The system, which comes in "Video Gray" to match today's TVs, includes five two-way, magnetically shielded satellite speakers and a subwoofer powered by a built-in 75-watt digital amplifier.

The satellites measure a slim 8.5 × 4.5 × 5.5 inches. Each uses a high-output, 4-inch woofer and a half-inch dome tweeter that operate in conjunction with an elliptical waveguide said to provide controlled directivity and accurate dispersion over a wide listening area. Installation is simplified by the satellite's integrated mounting brackets and by Infinity's "room-friendly acoustical design principles," said to ensure sonically accurate performance in a variety of listening environments and placement positions.

The HTS-10's powered subwoofer provides the solid, powerful bass needed to reproduce Dolby Digital's low-frequency effects channel. Measuring 11-inches square, the subwoofer includes continuously variable-level and crossover-frequency controls, as well as line-level and high-level inputs.

Infinity Systems, 250 Crossways Park Drive, Woodbury, NY 11797; 800-553-3332; *www.infinitysystems.com.*

CIRCLE 53 ON FREE INFORMATION CARD

Heard, but Not Seen

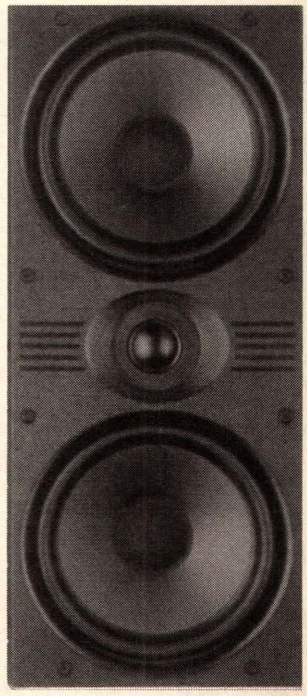
When the lights are on and the TV is off, many folks would prefer not to see home-theater gear cluttering up the room. TVs and other components can be hidden in a closed cabinet. And, with the *System 10* from Atlantic Technology, the speakers ($429 each) can be hidden in the walls. The System 10 was designed as a full-range stereo speaker that could integrate smoothly with Atlantic Technology's subwoofers and dipole surround speakers to provide outstanding music and home-theater surround sound.

The System 10 has a central swiveling 1-inch dome tweeter that can be aimed for optimum dispersion, and its front-panel high-frequency level control can boost or cut tweeter output by 2 dB. Two long-throw 6.5-inch woofers include powerful motors, rubber surrounds, and magnetic shielding. The System 10 is configured as a D'Appolito array, which is said to provide excellent control of vertical dispersion and enhance the speaker's imaging.

As a center-channel speaker, the System 10 can be installed above or below the video monitor or behind an acoustically transparent projection screen. As long as it is installed well off-axis above and behind the listener, it can also serve as a surround speaker.

The speaker is easy to install in any standard construction wall. Once it has been positioned in the wall cut-out, the rotating mounting clamps are screwed down to lock the speaker tightly against the wall board.

Atlantic Technology, 343 Vanderbilt Avenue, Norwood, MA 02062; 781-762-6300; *www.atlantictechnology.com.*



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Sega Dreamcast

Videogame consoles may never be the same again as a new standard for excellence is set.

Ever have a dream so vivid you woke up thinking it was real? Well, plug in Sega's *Dreamcast* ($199) videogame console, pop in *Sonic's Adventure*, and the opening animation—a cityscape plagued by disasters ranging from a wall of rushing water to the landing of a hostile spaceship with a lizard-like alien—will have you doing a double take. The close-up of the blinking reptilian eye, in particular, looks like real video footage.

Alas, that degree of realism does not extend into the game action itself. But the 128-bit Dreamcast, with its 200-MHz SH4 RISC processor and a graphics engine based on the NEC Power VR2 chip, does represent a dramatic step forward in videogaming as we've previously known it, on the 32-bit Sony PlayStation or the 64-bit Nintendo 64. Besides enhanced (up to 60-frames-per-second) graphics and increased processing speed, the Dreamcast features a built-in 56-Kbps modem for multi-player online gaming (still to come as of this writing), and a memory card that doubles as a miniature portable videogame.

Hot Hardware. The console itself is a white plastic unit measuring a diminutive 7.5 × 7.75 × 3 inches. The top-loading disc tray is flanked by POWER and OPEN buttons on each side. The rear panel provides a phone jack for the internal modem, a set of A/V jacks, a connector for the power cord, and a serial port "for possible future expandability." The front panel provides four (count 'em, *four*) controller ports. Additional controllers cost $30 each.

The controller has a joystick-style "analog thumb pad" and a digital directional pad ("D-pad") on the left side, four buttons (A, B, X, Y) on the right, and the START button in the middle. Two wing-like handles protrude from the front; each has a trigger switch behind it, accessible with the player's index finger. The cable sticks out the player's side of the controller, which is a bit awkward. We suppose Sega put it there to make room on the other side of the controller for two expansion slots.

Each controller can hold two Visual Memory Units, or VMUs (sold separately, $25 each). With four controllers connected, as many as eight cards can be managed at once. (Another option is to use the second slot for an optional Jump Pack, which uses a force-feedback engine to allow players to feel crashes and explosions. Each Jump Pack also costs $25.)

The Visual Memory Units do much more than simply store game scores. Each VMU has its own LCD screen and a directional control pad, along with POWER, MODE, SELECT, and CANCEL buttons. The connector at the top of the card is used to plug it into the Dreamcast controller—or into other VMUs, to trade information. When it's inserted into the controller's upper slot, the LCD is visible to the player. In some games, such as *NFL 2K* (more on this in a moment), game strategy can be worked out on the VMU's small screen, where no other player can see it, before being played out on the big screen. Remove the VMU from its slot, and it becomes a portable gaming machine. Download game characters, and you can train them while riding in a car. Play stand-alone VMU games, and you can earn bonus points or discover new levels of play when the card is plugged back into the controller and regular play resumes.

Sizzling Titles. And you'll be resuming regular game play whenever you get a chance. *Sonic's Adventure* ($49.99), starring that old favorite, Sonic Hedgehog, is an excellent example of the Dreamcast's speed, 3D graphics, and visual realism. Sonic and his furry friends have close to 50 levels to explore

as they search for Chaos Emeralds and try to save the world from the evil Dr. Robotnick. You can opt to be Sonic or any of his five friends—all of whom move at incredible speeds. The details are incredible. When Sonic runs across a beach, for example, he leaves a trail of footprints in the sand.

Similarly, the players in *NFL 2K* ($49.99) leave cleat marks in the grass (or astroturf, depending upon which of the 32 accurately modeled stadiums is home to the game). Details that ring true enhance the sense of realism. Weather conditions affect game play, for instance, and spectators desert the stadium in droves during a blowout—or scatter when a player runs out of bounds.

As of October 1999, there are about 20 Dreamcast games on the shelves, with about a dozen more due in time for the holidays. Arcade favorite *Soul Calibur* is available, as is a 3D version of *Mortal Kombat*. A sampler disc of new or soon-to-be-released titles showed similar speed, accuracy, realism in a slew of shoot-'em-up, fighting, strategy, sports, and racing games. And, while *Bass Fishing* seemed an unlikely theme for a videogame, the bait's-eye views and the ability to "get into the head" of the fish combined to create fun and challenging game play.

Unfortunately, the Dreamcast Internet connection isn't expected to be fully operational until sometime in the Spring, so we couldn't experience first-hand the thrill of online multi-player gaming—or of sending and receiving e-mail via a game console. (For sending e-mail and other Web-browsing tasks, a Dreamcast keyboard is free with a subscription to AT&T WorldNet Service, or can be purchased for $25.)

But even without the Internet dimension, Dreamcast has plenty going for it. It's definitely first in its class—at least until Sony's new PlayStation, planned for late 2000, shows up!

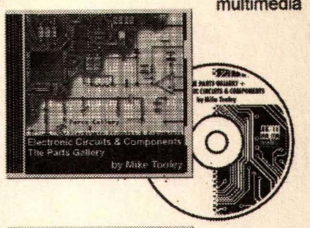
For more information on Dreamcast, contact Sega, PO Box 7654, San Francisco, CA 94129; 888-271-5678; *www.sega.com*; or circle 80 on the Free Information Card. P

Electronics CD ROMs

produced by: matrix multimedia

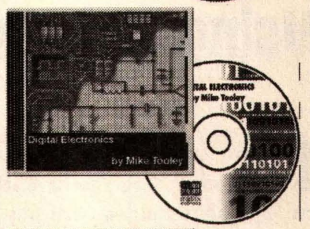
Want to improve your design skills?

Then you should consider our range of CD ROMs by best-selling author **Mike Tooley**.

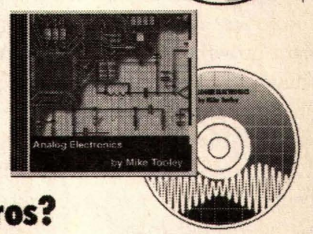


Electronic Circuits and Components provides a sound introduction to the principles and applications of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analog circuits and digital circuits. Includes circuit s and assignments for Electronics Workbench.

The Parts Gallery has been designed to overcome the problem of component and symbol recognition. The CD ROM will help students recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included. The Parts Gallery is free with Electronic Circuits and Components.



Digital Electronics details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor-based systems. Includes circuit s and assignments for Electronics Workbench.

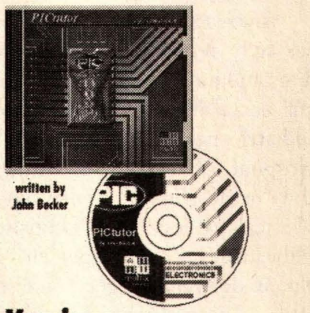


Analog Electronics is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits, which gives you the ultimate learning tool. The CD ROM provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

"...hammers home the concepts in a way that no textbook ever could."
Electronics Australia

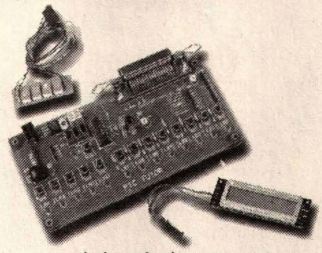
Interested in programming PIC micros?

We have the perfect solution:



Our PICtutor CD ROM can teach you how to write assembly language programs for the PIC series of microcontrollers. The CD ROM's 39 tutorial sections will guide you from basic PIC architecture, commands, and programming techniques up to advanced concepts such as watchdog timers, interrupts, sleep modes, and EEPROM data memory use. Over 80 exercises and challenges are provided to test your understanding, and the unique Virtual PIC allows you to write and test programs on-screen.

The complementary development kit includes a reprogrammable PIC16C84, which you can program via your printer port. The institution version (designed for use in schools, colleges and industry) includes a quad 7-segment LED display and alphanumeric LCD display. The development kit provides an excellent platform for both learning PIC programming and for further project/development work. Assembler and send (via printer port) software is included on the CD ROM.


development board (institution version)

Prices and Versions

Institution versions are suitable for use in schools, colleges and industry. Student versions are for student/home use.

	student version	institution version
Electronic Circuits & Components	$56	$159
Digital Electronics	$75	$189
Analog Electronics	$75	$189
PICtutor (CD and development board)	$179	$350

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see http://www.MatrixMultimedia.co.uk for full specs and demos

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Prototype

Using Light for Brain Tumor Surgery

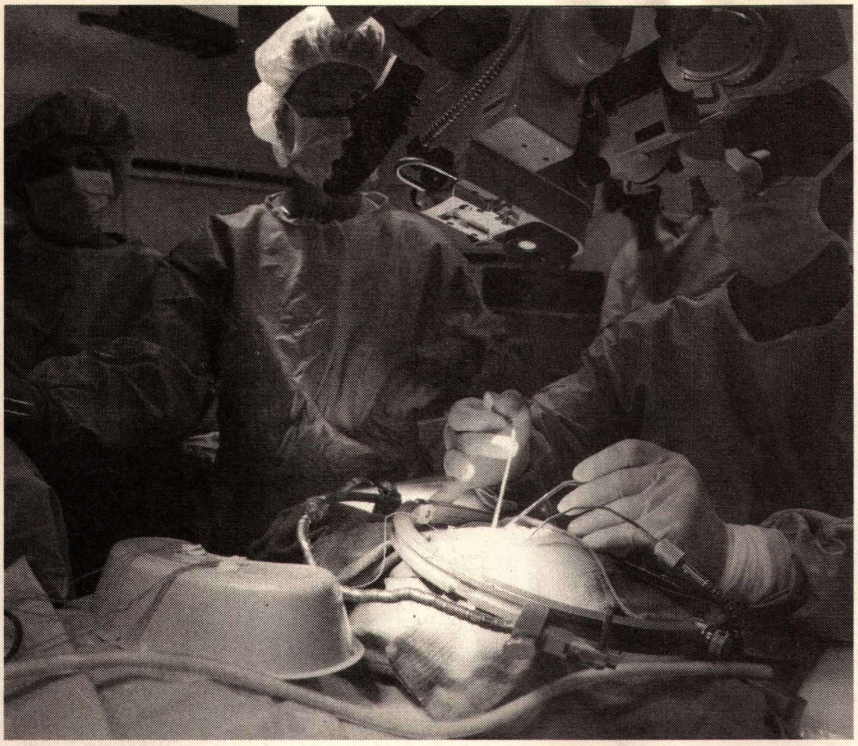
In two successful operations to treat brain cancer, surgeons have used a special lighting technology that was originally developed for space-based commercial plant growth research on NASA'a Space Shuttle. For the treatment technique called Photodynamic Therapy, a surgeon uses tiny pinhead-size Light-Emitting Diodes (LEDs)—a source releasing long wavelengths of light—to activate light-sensitive, tumor-treating drugs.

"A young woman operated on in May has fully recovered with no complications and no evidence of the tumor coming back," said Dr. Harry Whelan, a pediatric neurologist at the Children's Hospital of Wisconsin in Milwaukee and professor of neurology at the Medical College of Wisconsin, also in Milwaukee. Katie Pedersen, 20 years old, underwent surgery with the LED probe. She had turned to NASA-sponsored technology when she was out of options. She had endured six surgeries over 10 years, as well as chemotherapy and radiation treatments traditionally used to treat cancer. But her aggressive cancer kept coming back.

"We are very hopeful that the LED's long, cool wavelengths of light were able to penetrate wide and deep enough to get rid of the tumor for good," said Whelan. In the more recent surgery on a young man, he continued "...everything looks great, and thus far there is no evidence of the tumor reoccurring."

Laser light has been used for this type of surgery in the past, but LED light illuminates through all the nearby tissues, reaching parts of the tumor that shorter wavelengths of laser light cannot. The new probe is also safer because the longer wavelengths of light are cooler than the shorter wavelengths of laser light, making the LEDs less likely to

Dr. Harry Whelan, a pediatric neurologist at the Children's Hospital of Wisconsin in Milwaukee, is shown holding the LED light source and its cooling/power system. The LED light source consists of 144 tiny diodes, is the size of a small human finger (about one-half inch in diameter), and is mechanically more reliable than other light sources used to treat cancer. (Photo by Emmett Given, NASA Marshall Space Flight Center.)



Neurosurgeons and nurses conduct a simulation of surgical implantation of the Light Emitting Diodes probe at the Children's Hospital of Wisconsin. The LED probe can be used for hours at a time and remains cool to the touch. (Photo by Emmett Given, NASA Marshall Space Flight Center.)

injure normal brain tissue near the tumor, explained Whelan.

The LED light sources, consisting of 144 tiny diodes, is compact—the size of a small human finger about one-half-inch in diameter—and mechanically more reliable than lasers and other light sources used to treat cancer. The entire light source and cooling system is only the size of a briefcase. The LED probe can be used for hours at a time while still remaining cool to the touch, and it can be purchased for a fraction the cost of a laser.

Experiments

Before the surgeries, Whelan and his colleagues performed experiments whose results indicated that when special tumor-fighting drugs are illuminated with LEDs, the tumors are more effectively destroyed than with conventional surgery.

Whelan has Food and Drug Administration approval to use the LED probe on a trial basis in the removal of children's brain tumors. To remove these tumors, Whelan's technique involves injecting the patient's bloodstream with a drug called Photofrin, a light-activated drug, currently approved in the United States for the treatment of certain lung and esophageal cancers. Photofrin was discovered at the Roswell Park Memorial Cancer Institute in Buffalo, NY, and is being developed by QLT Photo Therapeutics Inc. in Vancouver, British Columbia, Canada.

Photofrin attaches to and permeates unwanted tissues, leaving surrounding tissues unaffected. Whelan then places the new solid-state LED probe near the affected tissue to illuminate the tumor and activate Photofrin. Once activated by the light, the drug destroys the tumor's cells, leaving the tender brain stem tissues virtually untouched.

Research and Development

The LEDs have been used on seven Space Shuttle flights inside the Astroculture facility, a plant-growth chamber developed by the Wisconsin Center for Space Automation and Robotics at the University of Wisconsin-Madison, a NASA Commercial Space Center. The Commercial Space Centers are part of the Space Product Development Program, managed at NASA's Marshall Space Flight Center, which provides U.S. industry the opportunity to perform experiments in space with future profit potential and real-life applications on Earth.

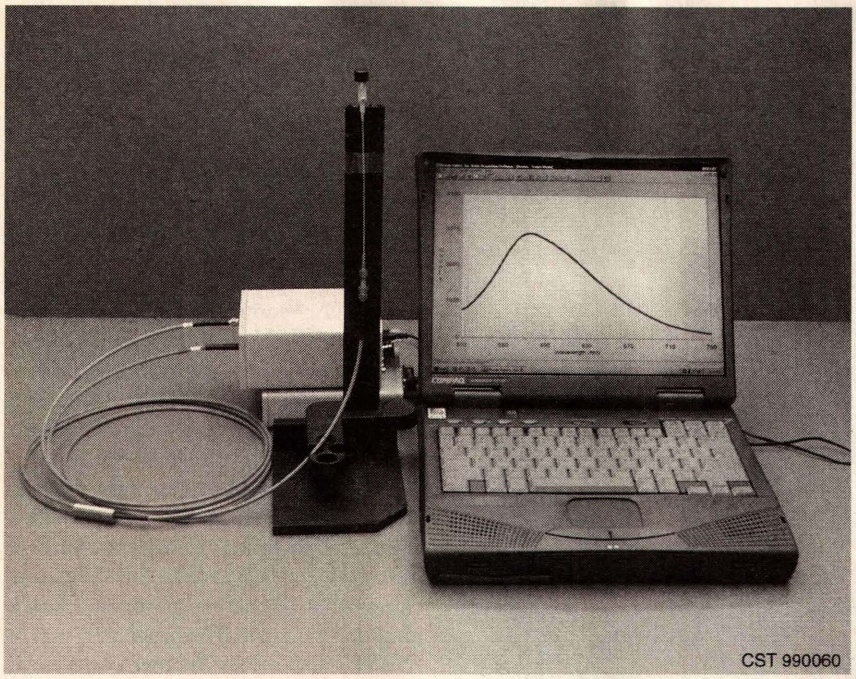
To ensure other LED applications are investigated, NASA recently selected a Phase II Small Business Innovation Research proposal for negotiation with Quantum Devices Inc. of Barneveld, WI—the company that developed LEDs for commercial plant growth investigations on the Space Shuttle. When the Phase II contract is awarded, Quantum Devices will receive $600,000 to continue promising research begun under the Phase I research contract.

"NASA was pleased to fund the first phase of the research leading to these two successful surgeries," said Helen Stinson, Marshall's manager of the Small Business Innovative Research program, which awarded the grant. The program is part of NASA's Technology Transfer Department at the Marshall Space Flight Center in Huntsville, AL. "We're happy to fund Quantum as it continues to explore cutting-edge medical uses for the LEDs." PT

Luminescent Biosensors

Researchers at the Department of Energy's Los Alamos National Laboratory have developed a method of using certain polymers as luminescent sensors to detect and identify biological and chemical agents, almost instantaneously. The polymers fluoresce in the presence of these agents with the help of molecular intermediaries that bind to the biological and chemical agents' receptor sites. Using a laptop computer, hand-sized spectrometer, fiber-optic cabling, and a sample holder, the researchers demonstrated the principle behind this technique by "turning on" a polymer's luminescence by adding the protein avidin, derived from egg whites.

Los Alamos researchers Duncan McBranch, David Whitten, Hsing-Lin Wang, and Liaohai Chen, along with Fred Wudl and Roger Helgeson from the University of California, Los Angeles, discovered they could use polymers as luminescent sensors while studying electron transfer in conducting polymers for possible applications in photovoltaics and nonlinear optics.



Shown here is a simple fluorescence sensor using the biosensing polymer-QTL solution. (Photo by Josh Smith. Los Alamos National Laboratory.)

Certain polymers transfer their electrons over to electron-accepting molecules when excited by laser light. However, the polymer's luminescence is "quenched" once the polymer transfers its electrons to the accepted molecule, which is attached to the polymer. The researchers discovered they could use this effect for sensing purposes by attaching a specific ligand to the acceptor molecule; the new molecule package then gets pulled away from the polymer by a biological or chemical agent's receptor site, restoring the polymer's luminescence.

All pathogens, proteins, viruses, and bacteria contain receptor sites, which allow them to latch onto specific ligands and provide a route for cells to be infected. By matching the right ligand with a receptor, researchers can positively identify the specific proteins, virus, or bacteria. The process is analogous to a lock and key. The ligand part of the molecular package, called a quencher-tether-ligand (QTL), is the "key," which fits into a receptor site, or "lock," on the biological and chemical species to be detected, explained McBranch.

To operate the device, McBranch and his colleagues place a water-soluble, quenched polymer inside a sample holder attached to one end of a fiber-optic cable. The other end of the cable connects to the spectrometer, which, in turn, connects to the laptop computer. The water-soluble polymer is essential because it contains the negative charge that attracts the positively charged QTL. In a recent demonstration, the QTL contained the ligand biotin. Next, the researchers added a solution containing the egg white protein avidin inside the sample holder. Biotin and avidin are a well-known ligand/receptor combination often used for biochemical binding studies, said McBranch. As expected, the receptors within the protein latched onto the QTL and pulled it away from the polymer. The spectrometer picked up the restored luminescence signal from the polymer and displayed it on the computer screen, confirming the presence of the protein. The analysis and identification process took about a second to complete.

The new sensors also may be able to detect viruses such as influenza and HIV, as well as bacteria and proteins, paving the way for further development of a lightweight, portable, real-time diagnostic tool that can be used in homes, clinics, and the field. PT

Supercomputers

Since the signing of the Comprehensive Test Ban Treaty in 1966, scientists have been looking for other ways to certify the U.S. nuclear stockpile as safe, secure, and reliable. The Department of Energy's Accelerated Strategic Computing Initiative (ASCI) is a 10-year science-based program for developing high-resolution modeling to support certification of the nuclear stockpile annually.

Today, ASCI-developed modeling and simulation are offering an alternative to banned, real-world testing. Ever-increasing computing speeds are necessary to fully simulate the complex 3-D physics of nuclear weapon-performance and analyze accident environments, such as simulating an airplane crash involving a nuclear weapon and a subsequent fuel fire.

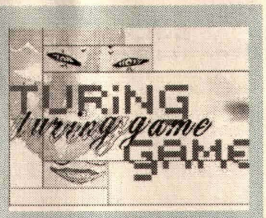
With DOE oversight, Sandia National Laboratories is working with Los Alamos and Lawrence Livermore national laboratories to ensure the ASCI goals are met. Although ASCI is just three years old, the prognosis is good. Having attained computer speeds of more than 3 teraflops, the program already is providing information to support certification of the nuclear stockpile. A teraflops refers to a Trillion Floating OPerations per Second.

ASCI hardware and software have produced reliable 3-D models that put into action relevant spatial dimensionality and detail, and physical principles to simulate catastrophic events. Although non-nuclear components can still be tested, computer simulations—which are really tests conducted in simplified virtual reality—provide a large amount of data for Sandia's annual recertification of weapons.

High-performance computing is paramount to analyzing intricate designs, said Dona Crawford, director of Sandia's advanced Product Realization Program. "We run hundreds or thousands of jobs. We can run a calculation a hundred different ways to get a better understanding, for the same money and same time needed for an actual test that provides only one finding (rather than hundreds)," she said. "ASCI is key to Sandia's weapons mission."

Today, high-performance, massively parallel computers allow researchers to simulate the complex 3-D physics involved in nuclear-weapons performance and to accurately predict the

➤ Online Identity



Interacting online with people throughout the world occurs daily for millions of Internet users, yet most of them have little perspective on the identity they're projecting. A multiplayer online game created by researchers at the Georgia Institute of Technology is offering insight to virtual community designers and members.

Called "The Turing Game," its object is to differentiate impostors from players telling the truth. Games can cover aspects of gender, age, race, religion, nationality, native region, or any other cultural marker of the users' choice. Differentiating impostors by the content and style of their online written communications will reveal insights into how various cultural markers affect a person's virtual identity, researchers said.

"Rather than just studying identity online, why not create a way for everyone—netizens and scholars alike—to learn more about it through personal experience?" said Joshua Berman, a Georgia Tech College of Computing doctoral student who developed The Turing Game with his advisor Dr. Amy Bruckman. "And why not try to make it fun as well as intellectually engaging?"

Bruckman compares The Turing Game to the old game show called "To Tell the Truth." "You have a panel of people with all but one of them pretending to be something they are not," she explained. "The audience asks questions via the computer, trying to determine which panelist is telling the truth."

The Turing Game is based on the "Turing Test," named after British mathematician Alan M. Turing. Its intention is to see if a person could distinguish the difference between men and women without being able to see them—basically doing it with written responses. Researchers hope to answer what they call some crucial questions for virtual community designers. "Is it possible to create a genderless classrooom? A raceless courtroom? A rich environment where a user can be not just a pseudonym, but a person with a full history of culturally bound experiences?" they ask on their Web site. "The Turing Game is a participatory collaborative learning experience to help us understand these phenomena."

The Turing Game is now available at *www.cc.gatech.edu/elc/turing/*. It will work on any computer running either Windows 95, 98, or NT 4.0. You must register to play online at any of the scheduled game times. PT

degradation of nuclear weapons components as they age in the stockpile.

"Driving parallel computing speed is a major contribution of ASCI to mainstream America. The things we do today (at the labs on high-performance computers) will be on your desktop in five to ten years," Crawford said. "Another contribution is the development of a new generation of science and engineering applications, algorithms and related technologies, and the basic approach of replacing test with simulation." PT

Putting Proteins to Work

A discovery linking the shape of a unit called the heme in a protein to protein function may prove useful in a range of scientific advances, including finding cures for diseases and cleaning up pollutants, says discoverer John Shelnutt, a physicist at Sandia National Laboratories. This is the first time such a correlation has been made. The discovery is being heralded by the biochemical and biophysical communities as one of the most intriguing new findings about proteins in years.

Protein strings of amino acids are found in all living cells and are where the work of a cell occurs. The heme, which consists of a ring of carbons and nitrogens, is the portion of a hemoprotein that clasps the protein's iron atom in place. A single protein may contain as few as one heme or as many as ten.

It was previously thought that the heme's primary function was simply to hold the iron in the protein so that the iron could carry out a chemical reaction. Scientists were unaware that the heme acted as part of the protein machine and changed shape (for th at matter) or even had a shape.

Shelnutt's discovery was made possible by a new computer program that uses a mathematical procedure for characterizing the structure of hemes in terms of normal coordinates. He believes this discovery might lead to changes in the way diseases are treated in the future or to other scientific advances. In collaboration with a French scientist, he is already using his knowledge to develop new anti-inflammatory drugs. PT

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Q&A

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

Putting Phone Calls on the Radio

Q *We need to take the audio from incoming phone calls and feed it to our radio transmitter. How can we do this?—Athens Academy Radio Club, Athens, GA*

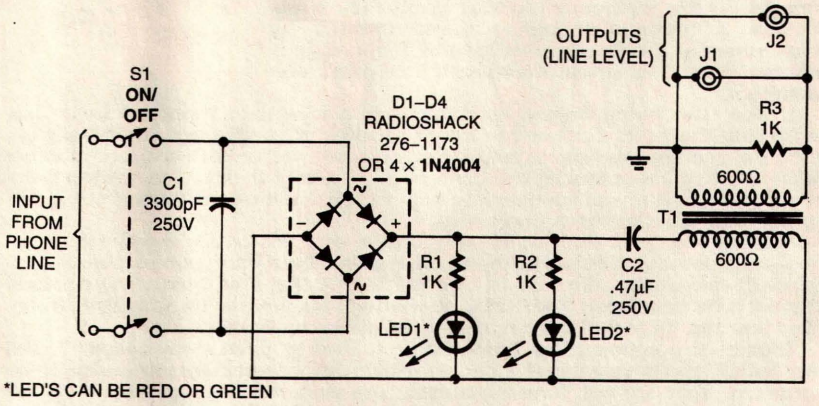


Fig. 1. This simple circuit lets you send a telephone conversation to any line-level input device: amplifiers, radios, etc. You can also feed line-level audio to a telephone for a type of "music on hold" arrangement.

A The circuit shown in Fig. 1 is a one-way telephone patch that you can use. It provides line-level audio (about 0.5 volt) from the telephone line while maintaining electrical isolation. Closing switch S1 is just like taking a telephone off the hook; the audio from the telephone call appears at the output.

Telephone signals are a mixture of DC and AC. The job of this circuit is to conduct enough DC to simulate a telephone, while separating the AC audio signal and delivering it at the output.

The phone patch input connects to the red and green wires of the phone line; it doesn't matter which is which. Capacitor C1 eliminates any RF that might be in the incoming signal—potentially quite a bit in a radio station. The bridge rectifier ensures that DC will flow through the LEDs in the right direction. They light up to indicate that the telephone patch is in use while drawing enough current to simulate a telephone that is off the hook. You can use either red or green LEDs. Capacitor C2 and transformer T1 separate audio (AC) from DC. You can salvage a suitable transformer from a junked modem or answering machine or use RadioShack 273-1374. The exact impedance isn't critical as long as it's a few hundred ohms on each side. Don't use an 8-ohm audio-output transformer.

We understand that you will use this primarily for calls from reporters as well as using the telephone line as a remote audio link. Naturally, you must not broadcast any telephone call without the caller's permission. It would be best to check the laws in your state governing telephone calls before you put anything on the air. You can also use this circuit to feed an incoming phone call to a PA system.

You could probably use the same circuit in the opposite direction to feed audio into the telephone line (for music-on-hold or the like). What this circuit can't do is pass audio signals in both directions at the same time; you would need a two-way phone patch with a special transformer. Some editions of the *ARRL Handbook for Radio Amateurs* describe such a circuit.

As Easy as (Leaving Out) Pi

Q *In the March 1999 issue of* **Electronics Now**, *the formula on page 34 for the resonant frequency of an LC tuned circuit is given as:*

$FR=1/(2\sqrt{LC})$

I thought it was:

$FR=1/(2\pi\sqrt{LC})$

Why the difference?—L. J., Atlanta, GA

A We had a misprint. The second formula you gave, with pi (π) in it, is the correct one. Here, L is in henries, C in farads, and FR in hertz.

On Solid Ground

Q *On page 41 of the November 1999 issue of* **Electronics Now**, *only one power-supply connection is shown (an arrow labeled "+5V"). Where do I connect the other side of the power supply?—D. J., Port Richey, FL*

A That connection is made to circuit ground (pin 4 of the LM4862). That's also where you connect the "ground" side of the input source. All of the points marked by the ground symbol are connected together and are used as a common reference point for signals and voltages. See this column in **Poptronics**, January 1999, for further explanation and a diagram.

A true dual power supply—used with op-amps—would have positive and negative wires, plus ground. You can make one out of two 9-volt batteries in series. Connect the point where the two batteries join to circuit ground. The remaining two terminals are +9V and –9V.

Keyboard Transplant Found

Q *In the October 1999 "Q&A" column that appeared in* **Electronics Now**, *a reader asks how to connect an AT&T 6310 keyboard to a PC-compatible computer. The AT&T keyboard uses a nine-pin DB connector and the PC keyboard uses a five-pin DIN plug.*

Only four wires need to be connected. The corresponding pins are: AT&T pin 2 to PC pin 1, AT&T pin 3 to PC pin 2, AT&T pin 1 to PC

pin 3, and AT&T pin 9 to PC pin 4.
A ready-made adapter is available from Computer Cable & Connector, Inc., Tel. 973-992-9285.—A. P. L., Florham Park, NJ

A Thanks! Reader Ernest Ford also wrote to point out that the AT&T 6310 is a PC XT-type keyboard and will probably not be fully functional with a PC AT-compatible computer. No harm will result from trying, though, and most of the keys will probably work.

Soprano, Alto, Tenor, or Bass?

Q *What type of test equipment would I need to measure the frequency of a person's voice?–J. S., Mt. Morris, IL*

A Ideally, you would need a calibrated oscilloscope, a microphone, and an amplifier to raise the microphone's output to line level or speaker level. The reason an oscilloscope is needed is that the waveform of a human voice is complex and constantly varying. The only way to be sure that you're measuring the frequency of the vocal cords, rather than one of the many harmonics generated in the vocal tract, is to look at the waveform, picking out what you want to measure. Oscilloscopes are calibrated in milliseconds; the frequency is the reciprocal of that. For example, if the waveform repeats every four milliseconds, the frequency is (1000/4) = 250 Hz.

You might be able to use a frequency counter in place of the oscilloscope if the person whose voice is being measured will make a constant sound with a simple waveform (such as "oooooo") and if the frequency counter works at audio frequencies; some don't.

Naughty Kids

Q *Although we can't prove it, my neighbors and I have a problem with some local teenagers. They have bought a device that scrambles our TV reception. Not all of our TVs are affected at the same time, so we don't know if they have to be near our houses for it to work. They have also bragged about a device that makes dogs go howling mad.*
What frequencies are these devices working on, how close do they have to be in order to work, and is there anything we can do to keep our TVs or our dogs from being affected?—M. H., Rockview, WV

A Some people think that when technology is involved, they are above the law. But deliberately interfering with TV reception is illegal, and so is cruelty to animals. Not only that, but anyone with half a brain should realize that doing those things is wrong, no matter how much technical skill it may demonstrate (in this case, apparently not much).

I assume that you receive TV through antennas, since cable systems are resistant to interference. The interfering device is presumably a low-power transmitter on the same frequency as one or more TV channels. The "dog-zapper" probably emits sound too high-pitched for humans to hear. In both cases, the range is probably only a few hundred feet. The effect will be strongest very close to the device and will fall off rapidly at greater distances.

Since you're in West Virginia, you should report the deliberate TV interference to the Federal Communications Commission, 9200 Farm House Lane, Columbia, MD 21046; Tel. 888-992-9285. Make sure you let them know that the interference is deliberate, since most interference isn't. You will probably also find it useful to contact your local ham radio club, since hams have direction-finding equipment. You can locate hams through local electronics stores and through the American Radio Relay League, Newington, CT 06111.

Since it uses sound waves, the dog-zapper is outside the FCC's jurisdiction, but your local police will be glad to help you if someone is torturing your dog, whether with sound waves or by any other means.

Radio-Direction Finding Loops

Q *Can you tell me where to find nuts-and-bolts-level information on radio-direction finding loops such as were popular in the 1920s and 1930s?–V. K., Kansas City, MO*

A Try the *ARRL Handbook for Radio Amateurs*, published by the American Radio Relay League, Newington, CT 06111. Hams still enjoy "foxhunts" in which they search for a hidden transmitter, usually in the 144-MHz band. Direction-finding antenna designs can be scaled up or down for any frequency. Antenna size is proportional to wavelength.

Ein Deutscher DMM

Q *I need the instructions in English for a Conrad Electronic model VC-4095CE digital multimeter that I bought in Germany.–K. C., Marquette, MI*

A Unfortunately, Conrad Electronic is a German company and has probably never published those instructions in any language but their own. You'd have to pay a translator hundreds of dollars to translate the 28-page instruction book.

However, DMMs are all very much alike, and you can probably find one marketed in the United States that is similar if not identical; then write to its manufacturer and get the instruction book. I haven't found its exact twin, but the Wavetek 25XT and 27XT look like its close relatives. You can contact Wavetek at 9145 Balboa Ave., San Diego, CA 92123; e-mail: *testtoolinfo@wavetek.com*.

The most important thing about your meter is the specification sheet. According to the German manual you sent, that meter measures DC voltage to 1000 volts, AC voltage to 750 volts, capacitance to 200 μF, inductance to 20 henries, AC and DC current to 20 amperes, resistance to 2000 megohms, and frequency to 20 MHz. It also measures transistor h_{fe} (beta) and has a diode-check and continuity function. That's quite a meter!

VCR Stuck in Play

Q *I have a Magnavox VRU342AT21 VCR that seems to be stuck in play mode, even when I don't press the play button. The Magnavox service manual is only available in microfiche, not on paper, and Howard W. Sams doesn't have anything available for it. Can you help?–F. A., West Hartford, CT*

A The right thing to do is probably to order the microfiche (it should be cheap) and use your public library's equipment to view it and make prints of the pages that you need. In the meantime, if the play button appears to be stuck, test it and the surrounding circuitry.

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at *www.gernsback.com* for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci. elec tronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio. amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at http://www.hitex.com/chipdir/, or try addresses such as http://www.ti.com and http://www. motorola.com (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at *www.repairfaq.org*

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising over 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1995 only) are available from our Claggk, Inc., Reprint Department, P.O Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (http://www.arrl.org). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

Already Isolated?

Q *I read with interest your February 1999 column about building an isolation transformer. I bought a Sola 20-13-125 constant-voltage transformer at a surplus sale and would like to use it as an isolation transformer. How do I do that?–R. G., N. Logan, UT*

A Constant-voltage transformers use magnetic saturation to hold the output voltage constant while the input voltage can vary a few percent. They are often used with photographic enlargers and other equipment that would be affected by small changes in the line voltage. As far as I know (never having actually taken one apart), the schematic is the same as an ordinary transformer except for the special magnetic material used inside.

What you have is probably already an isolation transformer. To check, just use an ohmmeter to make sure that the primary is not connected to the secondary. If that's the case, you can use it as an isolation transformer with no further modification. Otherwise, if it's not already an isolation transformer, there's no easy way to turn it into one.

You can contact Sola c/o American Falcon Intl. Inc., 648a Berlin Cross Keys Rd., Sicklerville, NJ 08081; Tel. 609-782-8600.

Sanyo TV Repair

Your October 1999 column in **Electronics Now** *described two 25-inch Sanyo televisions that don't get cable channels. Resistor R508 (a 39-kilohm, fi-watt film resistor) needs to be replaced. It is a scan-derived power supply for the tuner and is a common fault in this chassis.–Al Baker, via e-mail.*

Thanks!

The Boolean Boogie?

Q *Your May 1999 "Q&A" column that appeared in* **Electronics Now** *contained a letter from 15-year-old "B.B." asking for book recommendations. I suggest that he look at* Bebop the Boolean Boogie *by Clive Maxwell, published by LLH Technology Publishing in Eagle Rock, Virginia. It's a good introduction to digital logic, done with humor.–Rich Joerger, WB4EHG, Robnert Park, CA*

A It's humorous all right—and very good reading. Clive Maxwell's books are not quite like anyone else's, but they're very entertaining and understandable to beginners, while containing information that will be new even to experienced readers. Thanks for writing!

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

(1) include plenty of background information (we'll shorten your letter for publication);

(2) give your full name and address on your letter (not just the envelope);

(3) type your letter if possible, or write very neatly; and

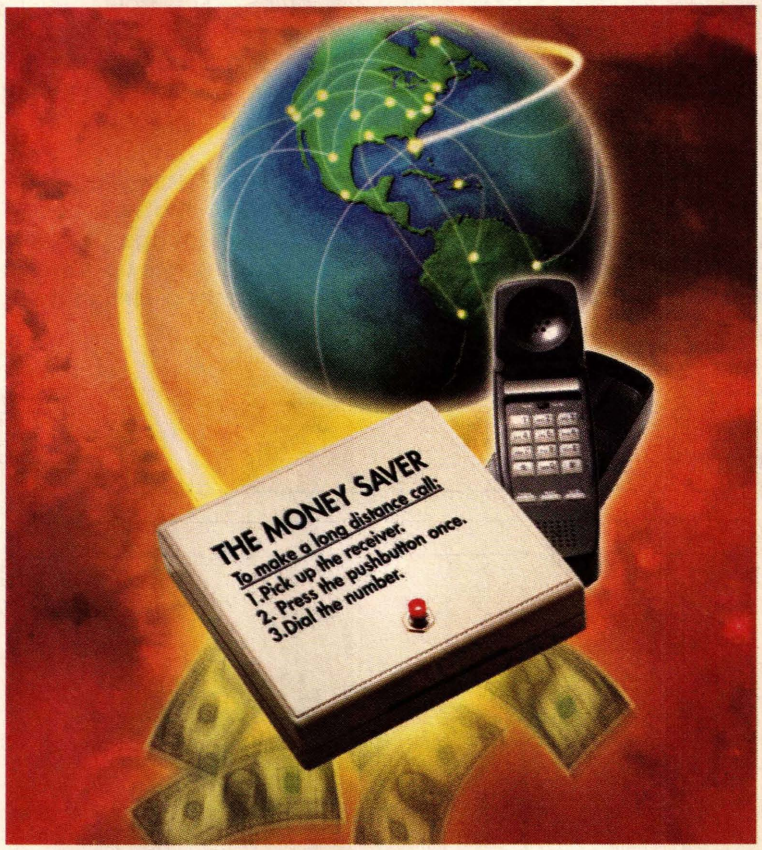
(4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Poptronics** Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to *q&a@gernsback.com*, but please do not expect an immediate reply (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. P

Cut Your Phone Bill with the Moneysaver

Having trouble remembering the access codes for those money-saving long-distance services? This simple device will do it for you!

ANTHONY J. CARISTI



Have you checked your long-distance telephone bill lately? Chances are you are paying way too much for long-distance calls, even if you participate in a calling plan. While some of those plans offer long-distance calling at 15 cents a minute or less, you might be paying a monthly fee. If you don't have a calling plan, you could be paying as much as an exorbitant 28 cents a minute for long distance!

The truth of the matter is that the cost of long-distance calling to the consumer is falling dramatically. When you consider that the actual cost to the carrier (ATT, MCI, Sprint, etc.) is about fi cent per minute, it is no wonder that competition is driving the price of telephone calls way down.

Over the past few years, "dial-around" services have sprung up all over America. These services let you make your calls at reduced rates. You simply dial a seven-digit code before the number that you're calling, bypassing your regular long-distance carrier. The access codes are easy to recognize; they usually start with the number 1010. Rates as low as 5 cents per minute with no monthly fee, no carrier switching, and no minimum calling time are presently available. These services are heavily advertised on TV and through the mail. They can also be found by doing a search for "dial-around service" on the Internet. If you are not taking advantage of these carriers, you are throwing money away.

This is where the *Moneysaver* comes in. It is a simple, easy-to-build electronic device that plugs into your telephone line, using no batteries or AC power. It is pre-programmed by you with the seven-digit code for your selected dial-around service. When you want to make a long distance call, simply pick up the telephone handset and press a pushbutton on the Moneysaver; the stored access code is dialed. You then dial the telephone number that you want to call as usual. With the Moneysaver helping you route your call through the discount services, you will save serious money from the first minute of calling.

The Moneysaver, designed for telephone systems with tone dialing, has no effect on normal telephone use. It comes into play only when the telephone handset is taken off-hook and the pushbutton is depressed. In fact, the Moneysaver may also be used as a rapid-dial device for any discrete local, long distance (including the discount code), or international call. Keep in mind, however, that only one dialing sequence at a time can be stored.

About the Circuit. The schematic

diagram for the Moneysaver is shown in Fig. 1; refer to it during the following discussion.

The Moneysaver is connected between a telephone and the wall jack; J1 connects to the telephone and J2 goes to the wall jack. Since the telephone lines carry the DC current that powers the Moneysaver, it is important that proper polarity between the red and green wires from the telephone company be observed or the Moneysaver won't work. Note also that proper polarity is maintained between the two jacks; some older telephone equipment is as polarity sensitive as the Moneysaver.

The heart of the circuit is IC2, a telephone-dialer chip that has redial capability. It contains a crystal-controlled oscillator circuit for generating dialing tones. Storage registers within the chip remember the pre-programmed dial-around code.

A set of four input and four output pins form a matrix for a 12- or 16-button keypad that can be scanned by IC2. Since using a full-blown keypad in the Moneysaver is overkill, a series of discrete switches are used instead. Of those switches, S1–S7, only S1 and S2 are shown as being connected to IC2. Those switches are wired to IC2 as the digits "1" and "0" respectively—the two digits that are required to access the various dial-around services. The other switches are optional and can be wired into the circuit as any digit that you want; we'll discuss that in greater detail later in the construction section of this article. For now, we'll just assume that there are additional switches in the matrix along with S1 and S2 that can be used for setting the stored number in the Moneysaver.

When the Moneysaver is first connected to the telephone line, C2 (a low-leakage electrolytic capacitor) charges up through R1 to about 5 volts as limited by Zener diode D4. That voltage is maintained at all times to retain the stored dial-around sequence code in IC2's memory as long as the Moneysaver is connected to the telephone line and is drawing current from it. The 5 microamps that the Moneysaver needs to work is well within the limits imposed by the rules concerning the switched public-telephone network.

When the telephone handset is picked up, current drawn by the phone flows through the light-emitting diode between pins 1 and 2 of optoisolator IC1, switching on the transistor between pins 4 and 5. Current then flows through D2 and R2, charging C3 to about 5 volts. That voltage is used to activate the circuit.

Once C3 is charged, Q2 turns on, providing a zero logic level to pin 11 of IC2, the hook-switch sensing input. When IC2 sees that input, it "wakes up" and starts scanning the switches. To dial out a long-distance access code (more on setting that later), simply press S8. That switch is wired into IC2's switch matrix as a "redial the last number" switch; the stored dial-around numbers are sequentially generated and appear at pin 13 of IC2.

The tones are coupled by Q1 to the telephone line through C4. Once the Moneysaver finished dialing the access codes, you can then manually dial your call in the normal way; the call goes through the long-distance carrier of your choice at the reduced rate.

When the call is completed and the handset placed back on the phone, the voltage at pin 11 of IC2 goes to a logic one. With the telephone now on-hook, IC2 is now ready for the next call.

The long-distance access code is programmed into the Moneysaver the first time power is applied. When any telephone is picked up, S1–S7 are used to dial the desired seven-digit access number that you want the Moneysaver to remember. After "dialing" the number with S1–S7, simply hang up the telephone; that number is saved in IC2's redial register. As long as the Moneysaver is connected to a telephone line, it will remember that number.

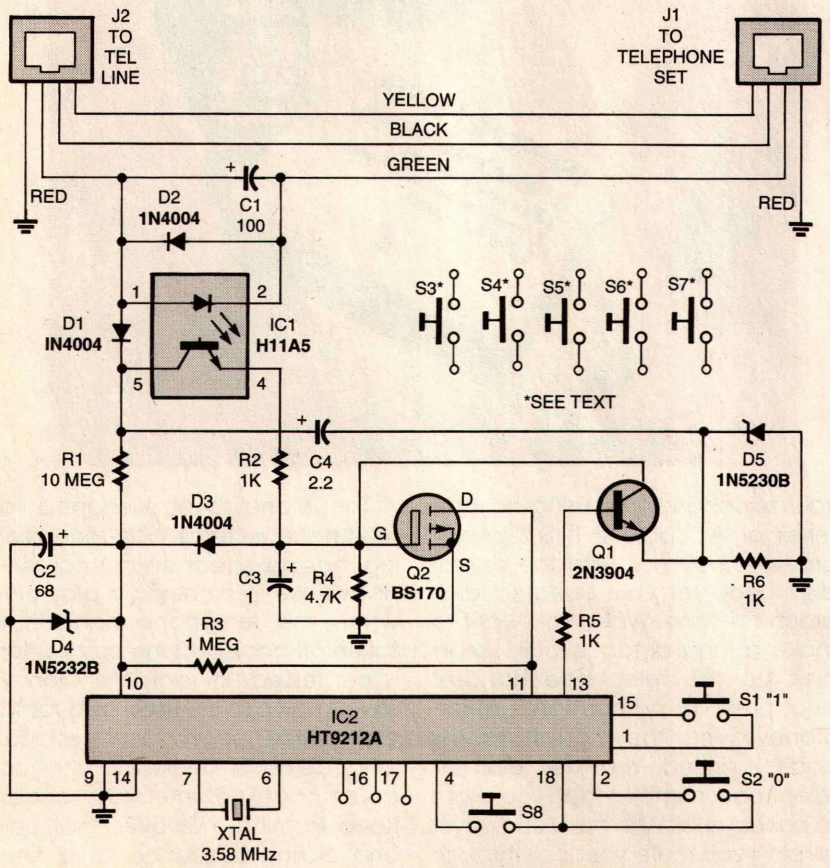


Fig. 1. The Moneysaver is built around a telephone-dialing chip that has redial capability. By storing a number such as a long-distance service access code in it, you can save money on your telephone bill with just a single button.

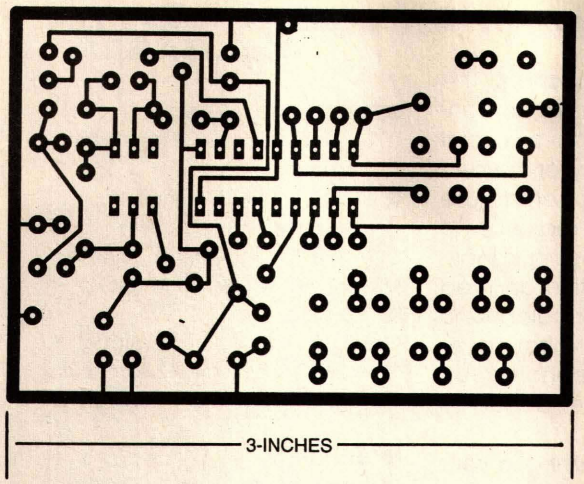


Fig. 2. The Moneysaver is simple enough in design to fit onto a single-sided PC board.

Construction. With careful construction techniques, the Moneysaver could be built on a piece of perfboard. While most of the circuit carries low-frequency signals, there are some high-frequency signals surrounding IC2 that could turn the Moneysaver into an RF transmitter if you are not careful to keep lead lengths short. Because of that concern, it is suggested that the Moneysaver be built on a printed-circuit board. To assist those that would like to etch their own board, a foil pattern has been included for a single-sided board layout; it is shown in Fig. 2. If you do not wish to etch your own board, one can be purchased from the source given in the Parts List.

For either of the above-mentioned methods of obtaining a PC board, follow the parts-placement diagram shown in Fig. 3 for component location. When placing polarized components such as solid-state devices and electrolytic capacitors into the board, be sure that they are properly oriented as shown. Just one part placed backwards in the circuit will stop it from working and possibly destroy itself or other components.

While on the subject of polarized components, make careful note of the working voltage of C7. A 250-volt rating is unusual for an electrolytic capacitor in many of the projects presented in the pages of **Poptronics**. That value, however, is vital so that C7 can withstand the telephone company's 90- to 150-volt AC ringing signal.

It's a good idea to use sockets for the integrated circuits; servicing is easier if you don't have to unsolder a multi-leaded device. Whether you decide to use IC sockets or not, do not insert the ICs into the board at this time; we'll do that later while testing the Moneysaver.

Switch Wiring. As we mentioned before, although IC2 is designed to use a matrix keypad, the use of such a keypad would be overkill for a project like the Moneysaver. Switches S1–S7 take the place of the keypad to keep the assembly cost down. The only switches that *must* be installed are S1 and S2; "1" and "0" are required to access any dial-around service.

Table 1

Digit	IC1	Connections
1	pin 1	pin 15
2	pin 2	pin 15
3	pin 3	pin 15
4	pin 1	pin 16
5	pin 2	pin 16
6	pin 3	pin 16
7	pin 1	pin 17
8	pin 2	pin 17
9	pin 3	pin 17
0	pin 2	pin 18
*	pin 1	pin 18
#	pin 3	pin 18

You only need to install as many switches for S3–S7 as needed for whatever number you would like to program into the Moneysaver. Those switches are hard-wired with short insulated jumpers so that they *appear* to IC2 as being part of a keypad matrix. See Table 1 for a chart that lists the connections needed for each individual number. Note that "1" and "0" are included in the chart for completeness; you don't need to wire those digits since S1 and S2 are already hard-wired that way.

For example, if you look closely at the photograph of the author's prototype, you'll see that S3 and S4

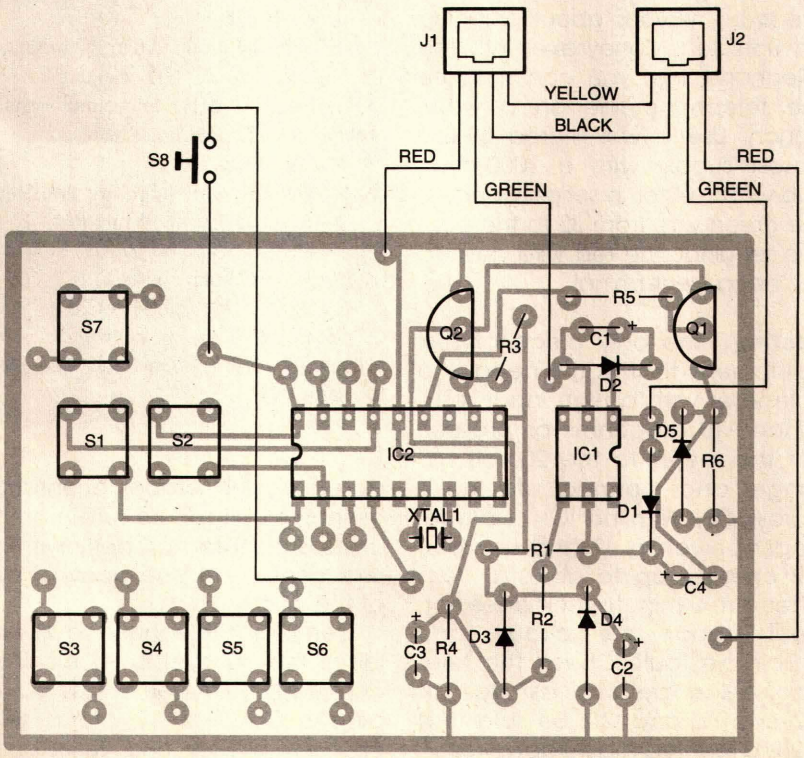
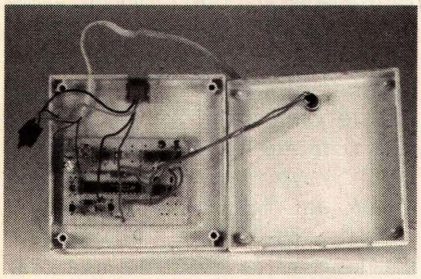


Fig. 3. Once the Moneysaver is built, you'll have to select which switches will be for which digits; they are wired according to the list in Table 1. You can use as many or as few switches are you desire; you can even use a keypad in their place.

are wired for "3" and "6" respectively; S5 is present but not wired. If you look at Table 1, you'll note that both of those digits need a connection to pin 3 of IC2, and that is why two wires are inserted in the hole that connects to that pin. If you find yourself in a similar situation, be sure to use small-gauge wire!

Switch S8 is a panel-mounted pushbutton switch that activates the Moneysaver's redial feature. It is wired to the PC board with lengths of insulated wire.



The author's Moneysaver uses a hard-wired modular-jack cable in place of J2. Note that S5 is installed, but is not wired into the circuit. Switches S3 and S4 are set for the digits "3" and "6." Those digits need to connect to the same pin on IC1, requiring two jumper wires to be squeezed into one hole.

Final Assembly. When the printed-circuit board is completed, examine it very carefully for proper parts placement, opens, short circuits, and bad solder connections that might look like dull blobs of solder. Any solder joint that is suspect should be redone by removing the old solder with desoldering braid, cleaning the joint, and carefully applying new solder. It is far easier to correct problems now rather than later on if you discover that your Moneysaver does not work as it should.

The Moneysaver is mounted into a small enclosure that has appropriate holes for J1, J2, and S8. As an alternative, you can substitute J2 for a length of four-conductor telephone wire that terminates in a modular plug; that is what the author did. If you use a jack, you'll need a length of telephone cord with modular jacks on each end. Either method works fine. If you happen to have appropriate supplies handy, use whichever method is cheaper!

We are now ready to connect up and test the Moneysaver.

Telephone Line Connection. The telephone-line cable must be connected to the Moneysaver circuit with the proper polarity or it won't work. Many telephone systems use a green wire and a red wire to carry the voice and ringing signals, with green being positive and red negative. Check your telephone line polarity with a DC voltmeter to be sure. With no telephones off hook, there should be about 50 volts DC on the line.

If you find that the wiring in your house is backwards, you can correct your house wiring provided that you know what you're doing. When in doubt, you can always hire a telephone-line installer to make sure that your house wiring is "up to snuff."

Note that most telephones are polarity insensitive. If you don't want to touch the wiring in your house (after all, "if it ain't broke, don't fix it!"), you can always swap the wires from J2 to the PC board if your house is wired backwards.

With J2 connected to a telephone wall outlet, we're ready to start testing the Moneysaver. If you are a bit nervous about plugging an untested Moneysaver into the telephone line, you can simulate the telephone line on a workbench. Use a well-filtered 50-volt power supply with a 1000-ohm, two-watt resistor in series. Connect the green wire from J2 to the positive terminal; the red wire goes to the negative terminal.

Testing. The only piece of test equipment that you'll need is a voltmeter with a high input resistance—10 megohms or greater. Set the meter to the 20-volt DC range and connect its leads across C2. With no ICs in place, apply power to J2 and see that C2 charges up to about 5 volts after a few minutes. If it does not, troubleshoot the circuit and repair the fault. Check the telephone-line polarity as well as D2–D4, R1, and C2. Be sure that C2 is a low-leakage capacitor.

Disconnect the power and insert the ICs into their sockets or solder them into the board, observing the proper orientation as shown in Fig. 3. Be sure that the chips are seated properly with no pins bent under the body of any of the chips.

Connect a telephone to J1 and leave the handset on hook. Then connect the meter across C2 as before. Connect J1 into a telephone wall jack and verify once again that C2 charges up to about 5 volts after a couple of minutes. Measure the voltage across

PARTS LIST FOR THE MONEYSAVER

SEMICONDUCTORS

IC1—H11A5 optoisolator, integrated circuit
IC2—HT-9212A DTMF dialer, integrated circuit (Holtek)
Q1—2N3904 NPN silicon transistor
Q2—BS170 N-channel MOSFET transistor
D1–D3—1N4004 silicon rectifier
D4—1N5232B 5.6-volt Zener diode
D5—1N5230B 4.7-volt Zener diode

RESISTORS

(All resistors are 1/4-watt, 5% units.)
R1—10-megohm
R2, R5, R6—1000-ohm
R3—1-megohm
R4—4700-ohm

CAPACITORS

C1—100-µF, 10-WVDC, electrolytic
C2—68-µF, 10-WVDC, low-leakage electrolytic
C3—1-µF, 10-WVDC, electrolytic
C4—2.2-µF, 250-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

J1, J2—Modular telephone jack, Digi-Key H9010-ND or similar
PB1—Pushbutton switch, panel mount, normally off
S1–S7—Pushbutton switch, PC mount, Digi-Key 8006S-ND or equal
XTAL1—3.579-MHz colorburst crystal
Telephone line cord, case, wire, hardware, etc.
Note: The following items are available from: A. Caristi, 69 White Pond Road, Waldwick, NJ 07463: Etched and drilled PC board, $14.95; IC1, $2.50; IC2, $9; Q1, $1; Q2, $2.75. Please add $5 for postage and handling. NJ residents must add 6% sales tax.

capacitor C3; it should be zero.

Pick up the telephone handset. You should hear the dial tone, and the voltage across C3 should rise to about 5 volts. Press the pushbuttons on the board to dial the sequence code of your selected dial-around service. You should hear the tones in the handset, and the telephone-line dial tone will be muted. Hang up the receiver; the Moneysaver is now initialized.

Pick up the receiver again and listen for a dial tone. Press S8 briefly. The dial-around sequence should automatically be repeated and the dial tone silenced. For a full test, dial a long-distance number using your telephone's keypad or dial. That call will use your selected long-distance discount carrier.

If you need to reset IC2 for any reason, disconnect the circuit from the telephone line and allow time for C2 to discharge to less than one volt. That will erase the memory in IC2, and it can be reprogrammed as described above.

If everyting went according to the above description, the Moneysaver is working and ready for use. If it didn't, here are some hints to help you locate and repair the fault.

First, make a visual check of the entire circuit board, looking for opens and short circuits, especially between closely spaced conductors. Check all of the solder joints. Are they shiny and smooth? Check the telephone cable connected to J2 for proper polarity.

Check all of the ICs for the correct part number; check that they are properly orientated as indicated in Fig. 3. Check all of the diodes, Q1, Q2, and the electrolytic capacitors for proper orientation.

If C3 does not charge up when the telephone handset is taken off hook, check IC1, IC2, D2, R2 and C3. Try replacing IC1—easy to do if you used sockets. See that there is no short circuit across C3 with an ohmmeter check.

If no dialing tones are heard in the receiver when S1–S7 are pressed, check pin 13 of IC2 with an oscilloscope to verify the presence of the tones, which will be a pair of audio frequencies. Check pins 6 and 7 of IC2 to verify that the 3.57 MHz oscillator is running. If not, try a new crystal for XTAL1. If pin 13 of IC2 is normal but the receiver and telephone line do not respond to the tones, check Q1, D5, C4, and R5. Try a new transistor.

If IC2 does not redial the stored sequence, check IC4, Q2, and S8. Try a new chip.

Using The Moneysaver. Once the Moneysaver has been initialized as described in the testing section above, it must be left connected to the telephone line at all times to preserve the stored sequence of digits. Should it be disconnected for any length of time, you will have to reprogram IC1 with the correct sequence. Use the procedure for reprogramming as mentioned above.

With the Moneysaver properly programmed, each time you wish to make a long-distance call simply press S8 after lifting the telephone handset, then dial the telephone number in the normal way. When you check your next month's telephone bill, you will be amazed at how much money you have saved.

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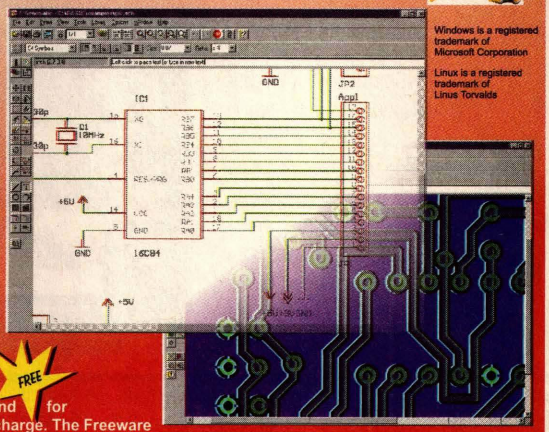

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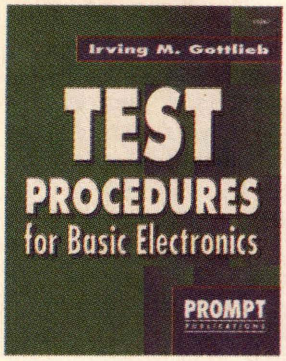

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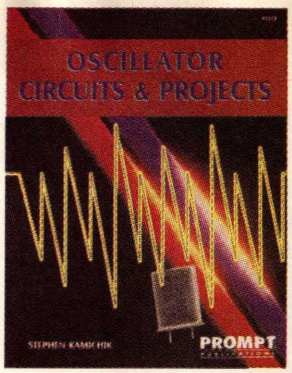

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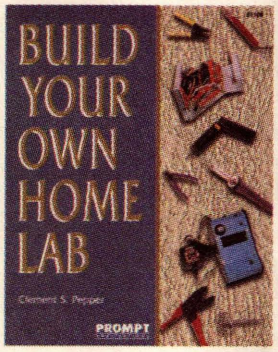

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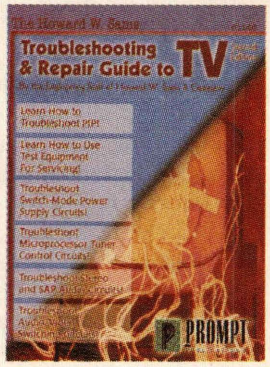

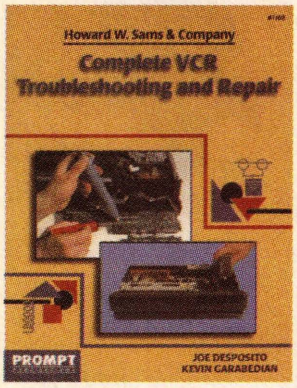

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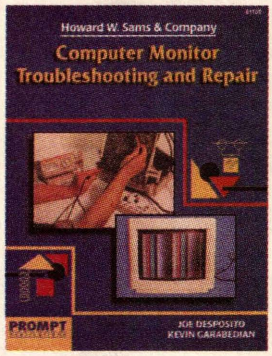

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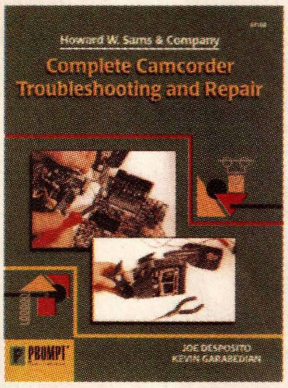

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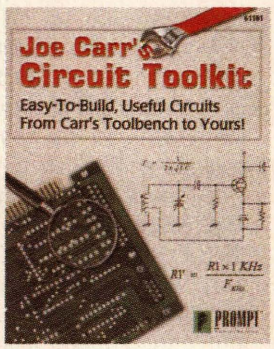

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Telephone Hold and Line-In-Use Project

BILL GREEN

Two simple circuits combine to take the hassle out of shared phone lines!

At our house, we share one phone line for voice calls and working the Internet. Now that's inconvenient! We have to inform others when we want to use the phone or check to see if someone is using it before we call or go online. If someone forgets, well, you know the hassle that can cause; picking up the phone and disconnecting the modem during an important search session or download, or maybe blasting away someone's ear when the modem dials and tries to negotiate a connection. To make matters worse, besides the modem/fax, we have several phones in the house. But there's more, and you have probably been here too; the phone rings and you pick up, but it's for someone else. So you lay the thing down to find the callee, go back and hang up the phone, or maybe not, or . . . and you know the rest . . .

Since none of this is good, I designed a Line-In-Use circuit that could be attached to each phone or modem. We needed several, so I wanted them to be simple and inexpensive. In addition, it was desirable that the circuit be small enough to fit inside the telephone housings. Further, I decided that while I was at it, I'd include another handy capability in the circuit; a Line Hold feature.

How It Works. The *Telephone Hold and Line-In-Use Project* is an extremely simple circuit built around a pair of MPSA42 transistors (Q1 and Q2), a 2N5064 silicon-controlled rectifier (SCR1), a pair of light-emitting diodes (LED1 and LED2), and a few support components. A complete schematic diagram of the circuit is shown in Fig. 1.

The Line-In-Use portion of the project revolves around the MPSA42 transistors, which were chosen for their collector-emitter breakdown voltage (300 volts); while the Telephone Hold section of the circuit is built around the 2N5064 SCR, which has a blocking voltage (peak-inverse voltage) of 200 volts forward or reverse. Each section of the project draws approximately 5 mA when active. The phone line has three states; on-hook, off-hook, and on-hook ringing. When on-hook, the line voltage is typically 40 to 60 volts; when off-hook, the line voltage ranges from 5 to 6 volts, and when ringing 70 to 140 volts. The reasons for the great variation are the length of the lines from the central office and the condition (resistance) of the wires. Typically the positive (+) wire (known as *ring*) is red and the negative (−) or common (called *tip*) is green. Most new phones and

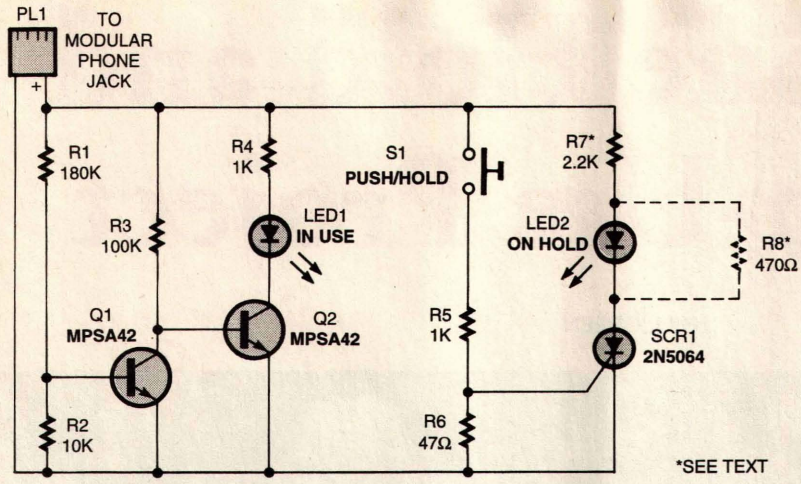

Fig. 1. As shown by this schematic diagram, the Telephone Hold and Line-In-Use Project is an extremely simple circuit built around a pair of MPSA42 transistors (Q1 and Q2), a 2N5064 silicon-controlled rectifier (SCR1), a pair of light-emitting diodes (LED1 and LED2), and a few support components.

modems work even if the polarity of the lines is reversed; sometimes, the in-house wiring is neither of those colors. For our circuits to work, the line connections must be properly polarized.

But enough with the background material, let's take a look at the project's subassemblies.

Line-In-Use Circuit. The Line-In-Use section of the project is comprised of Q1 and Q2, LED1, and R1–R4. When the phone is on-hook, R1 and R2, which form a simple voltage divider (refer to Fig. 1), supplies 600 mV to the base of Q1. That causes Q1 to turn on, pulling its collector to near ground potential. The low voltage at the collector of Q1 is applied to the base of Q2, keeping Q2 in the cutoff state. Since no current flows through Q2, LED1 does not light. But when the phone is taken off-hook the normal telephone-line voltage decreases, thereby reducing the base bias voltage applied to transistor Q1. The reduction in base bias causes Q1 to turn off.

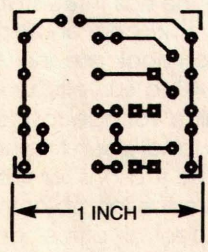

Fig. 2. The prototype of the Telephone Hold and Line-In-Use Project was assembled on a printed-circuit board, measuring 1 by ⅞ inches. The author's printed-circuit layout is shown here on a one-to-one scale.

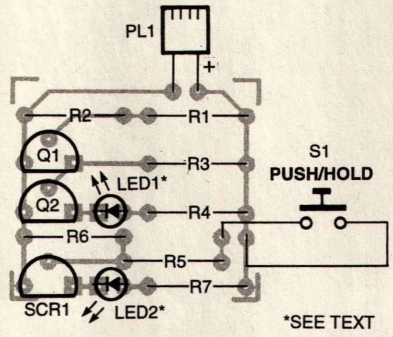

Fig. 3. Once you've etched your printed-circuit board and obtained all of the parts listed in the Parts List, assemble the tiny printed-circuit board guided by the parts-placement diagram shown here.

With Q1 turned off, its collector voltage rises to a level sufficient to bias transistor Q2 into conduction. With Q2 now conducting, current flows through Q2 and LED1, causing the LED to light, indicating that the line is in use.

Now, let's take a look at the second half of the circuit.

Line Hold. The Line Hold portion of the project is comprised of S1 (a single-pole, single-throw pushbutton switch), R5–R7 (R8 is optional and will be explained in a moment), LED2, and SCR1. Two of the resistors (R5 and R6) form a voltage divider that is connected in series with switch S1.

When S1 is pressed and held with the phone off-hook, current flows through the voltage divider to the gate of SCR1. That provides sufficient current to cause SCR1 to fire, but not enough current through it to cause it to latch. When the phone is placed back on-hook, the line voltage increases, causing a current of sufficient magnitude to flow through R7 to latch SCR1 and light LED1. Even after releasing S1, the LED remains on, signaling that the line is on hold (ignore?). When any phone on the line is picked up, the line voltage drops again to around 5 volts, so that the SCR is starved for current and turns off, releasing the hold on the line.

As mentioned earlier, R8 is optional. That resistor is included in the cir-

PARTS LIST FOR THE TELEPHONE HOLD AND LINE-IN-USE PROJECT

SEMICONDUCTORS

Q1, Q2—MPSA42 or equivalent NPN silicon transistor
SCR1—2N5064 or equivalent 0.8-amp, 200-PIV, sensitive-gate, silicon-controlled rectifier
LED1, LED2—Light-emitting diode, any color

RESISTORS

(All resistors are ⅛-or ¼-watt, 5% carbon film units.)
R1—180,000-ohm
R2—10,000-ohm
R3—100,000-ohm
R4, R5—1000-ohm
R6—47-ohm
R7—2200-ohm (see text)
R8—470-ohm (optional, see text)

ADDITIONAL PARTS AND MATERIALS

S1—Miniature momentary-contact push-button switch
PL1—Modular 4-conductor telephone plug
Printed-circuit materials, enclosure, wire, modular jack and plug and solder.
Note: For information about this project, Z-Flex foil and previous articles by this author, visit our Web site at: *www.lancelotddl.com* or by e-mail at: *lancelot@lancelotddl.com.*

cuit *only* if a flashing unit is used for LED2 in the Line Hold portion of the circuit to attract more attention. If you do use a flashing LED in the Line Hold circuit, change the value of R7 to 1000 ohms and add R8 across the LED, as indicated in the Fig. 1 schematic diagram. Resistor R8 helps to keep latching current flowing through the SCR during the blinking LED's off cycle, so as not to disrupt the operation of the Line Hold portion of the project. It is ill-advised to use a blinking unit for LED1 in the Line-In-Use portion of the circuit, as it can generate annoying clicking sounds in the handset as the LED flashes on and off.

Construction. The author's prototype of the Telephone Hold and Line-In-Use Project was assembled on a printed-circuit board, measuring 1 by 7/8 inches. A full-size template of the author's printed-circuit layout is shown in Fig. 2. (**Note:** The prototype was built on a printed-circuit board, using the Z-Flex foil material featured in another of this author's articles, "A New Way to Make PC Boards," which appeared in the November 1997 issue of **Electronics Now.** See the Parts List for information about Z- Flex.)

Once you've etched your printed-circuit board and obtained all of the parts listed in the Parts List, assembly can begin. Populate the tiny printed-circuit board guided by the parts-placement diagram shown in Fig. 3. As you assemble the project, be sure to take the usual precautions for projects with semiconductors, checking all parts for correct location, orientation, and polarity as well as proper solder joints. Because of the small size of the board, be extremely mindful that tiny solder splashes as well as the rosin used in the core of electronics solder is conductive and can in some cases lead to short circuits.

The LEDs can be the same or different colors, and the one used in the Line Hold portion of the circuit can be a blinking unit (as mentioned earlier) to attract more attention.

Installation and Use. As mentioned earlier, the polarity of your telephone lines may not be properly indicated by the color of the wiring. Measure the polarity with a meter so that you'll be sure that you are connecting the positive (+) circuit-board trace to the RING input of PL1 and the negative trace to the TIP terminal. The board can be installed inside the telephone housing or mounted in a small plastic modular jack box, as the author did with his prototype. Using the Line-In-Use circuit requires no instructions. Using the Line Hold circuit is simple; with the phone off-hook, press and hold S1, and then place the phone on-hook and release S1. The LED will stay lit until any phone is taken off-hook again. Ω

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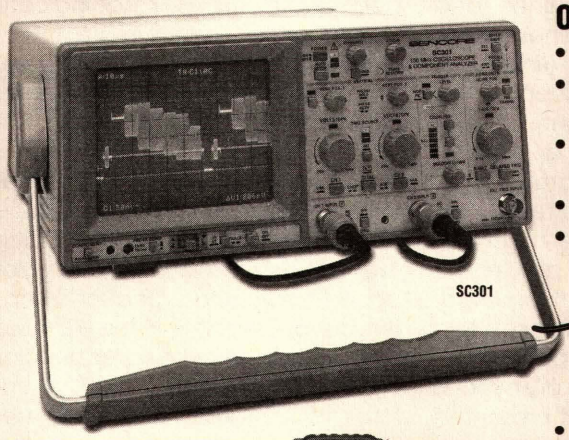

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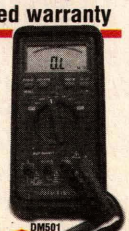

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CIRCLE 138 ON FREE INFORMATION CARD

the call director: a distinctive-ring decoder

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JOHN TAYLOR, JR.

Many telephone companies across the country provide a variety of convenient calling features that let customers enhance their basic services. Those features include Call Waiting, Call Forwarding, Three-Way Calling, Caller ID and Call-Waiting Caller ID, and Distinctive Ringing (also called RingMaster in various parts of the country), just to name a few.

The custom calling feature referred to as Distinctive Ringing is a clever service that permits the use of up to four telephone numbers on one telephone line. Each telephone number has its own distinctive ringing pattern, letting you know which number was dialed before answering your telephone. By providing the additional telephone numbers to different people, you can identify who a call is from based on its ringing pattern. If you have school-age children, they can have their "own" telephone number; with Distinctive Ringing, you can tell your calls from theirs. For those with a home-based business, the Distinctive Ringing service is an inexpensive alternative to paying for a second telephone line. Like the family example above, you can tell if it's a personal or business call—a situation that the author uses to advantage!

Distinctive Ringing service, however, has its limitations when it comes to supporting multiple telephone-line devices such as answering machines, fax machines, and modems. While Distinctive Ringing support has been added to some of the latest computer fax/modems, most answering machines and dedicated fax machines don't know what Distinctive Ringing is. Suppose you want to support two answering machines: one for your personal calls, and a second machine for your home-based business calls. When the telephone line rings, both of those machines will see the ringing line, answer the call, and begin playing their outgoing messages—an event that is sure to confuse your calling party!

The solution to that dilemma is the *Call Director* project presented here. This Distinctive Ringing decoder suppresses the first ring of all incoming calls while it analyzes the ringing pattern. Once the ring pattern is understood, the Call Director switches the ringing line to the appropriate telephone, answering machine or other telephone-line device. The Call Director features support for up to four telephone numbers (the main number plus up to three Distinctive Ringing numbers) and status LEDs that indicate which port is currently in use.

While those features are nice, the best is that the Call Director can be built for as little as $25.

How It Works. In general, a telephone ring signal is an AC voltage of between 40 and 150 volts that is impressed on the line. The telephone senses that signal and rings the bell accordingly. In the US, there are several different frequencies defined by the FCC tests for on-hook AC impedance. Those frequencies were used back in the days of the "party line." In a party line, several customers used one telephone line. Each customer had a telephone that responded to a particular frequency, so only one telephone would ring for a particular telephone number. While party lines are very rare nowadays, the standards are still in place. The stan-

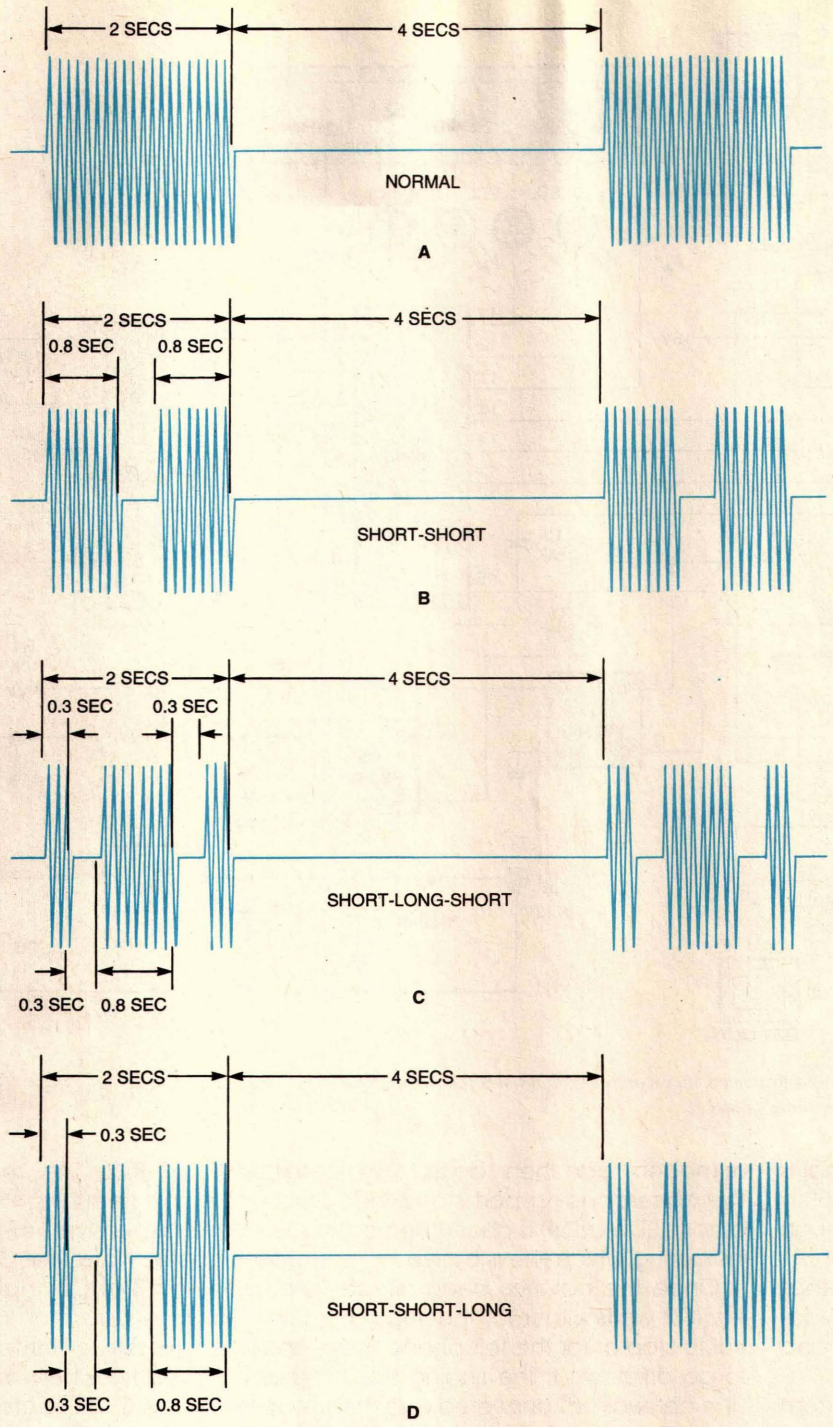


Fig. 1. A normal ring signal in the US consists of a two-second ring period followed by four seconds of silence (A). Three additional ring patterns are available under Distinctive Call service. Those patterns include two short bursts (B), a short-long-short pattern (C), and two short bursts followed by a long ring (D).

dards are referred to by a letter. If you look on the FCC identification label on a modern telephone, you'll usually see a line saying "Ringer Equivalence" followed by a number and a letter. The number is the amount of relative current that the telephone's ringer draws from the telephone line; a value of 1.0 is the same as a standard mechanical ringer. The letter is the frequency response band; it will usually be a "B." The "B" classification is the general-purpose wideband response between 15.8 and 68 Hz. That frequency range covers the entire spread of available ringer frequencies.

The typical ring cycle in the US is six seconds in duration: two seconds on and four seconds off. You can see what the pattern looks like in Fig. 1A. With Distinctive Ringing service, the additional telephone numbers each have a slightly modified ring pattern. Those patterns can be seen in Figs. 1B, 1C, and 1D.

The Call Director is connected directly to the telephone company wires; each controlled telephone is then connected to the Call Director's output jacks. When the telephone line rings, the Call Director suppresses the first incoming ring while it analyzes the pattern, determines which telephone number was dialed, and directs the call to the appropriate telephone jack.

Circuit Description. The complete schematic diagram of The Call Director is shown in Fig. 2. The telephone company line is connected to J1, with J2 through J5 serving as the four individual lines to the telephones themselves. The telephones on J2 through J5 are connected to J1 with relays RY1 through RY4. Normally, those relays are deactivated, connecting all four lines to J1 through the normally-closed contacts. That way, any telephone can be picked up and a call dialed out.

If any telephone is picked up, the 20- to 25-mA current loop that is created between the off-hook telephone and the telephone company's central office is sensed by the voltage drop across R5. That voltage drop activates optoisolator IC3, lighting up LED5 to indicate that the line is in use. A nice feature of IC3 is that its inputs are bi-directional—you don't have to worry about the telephone line's polarity.

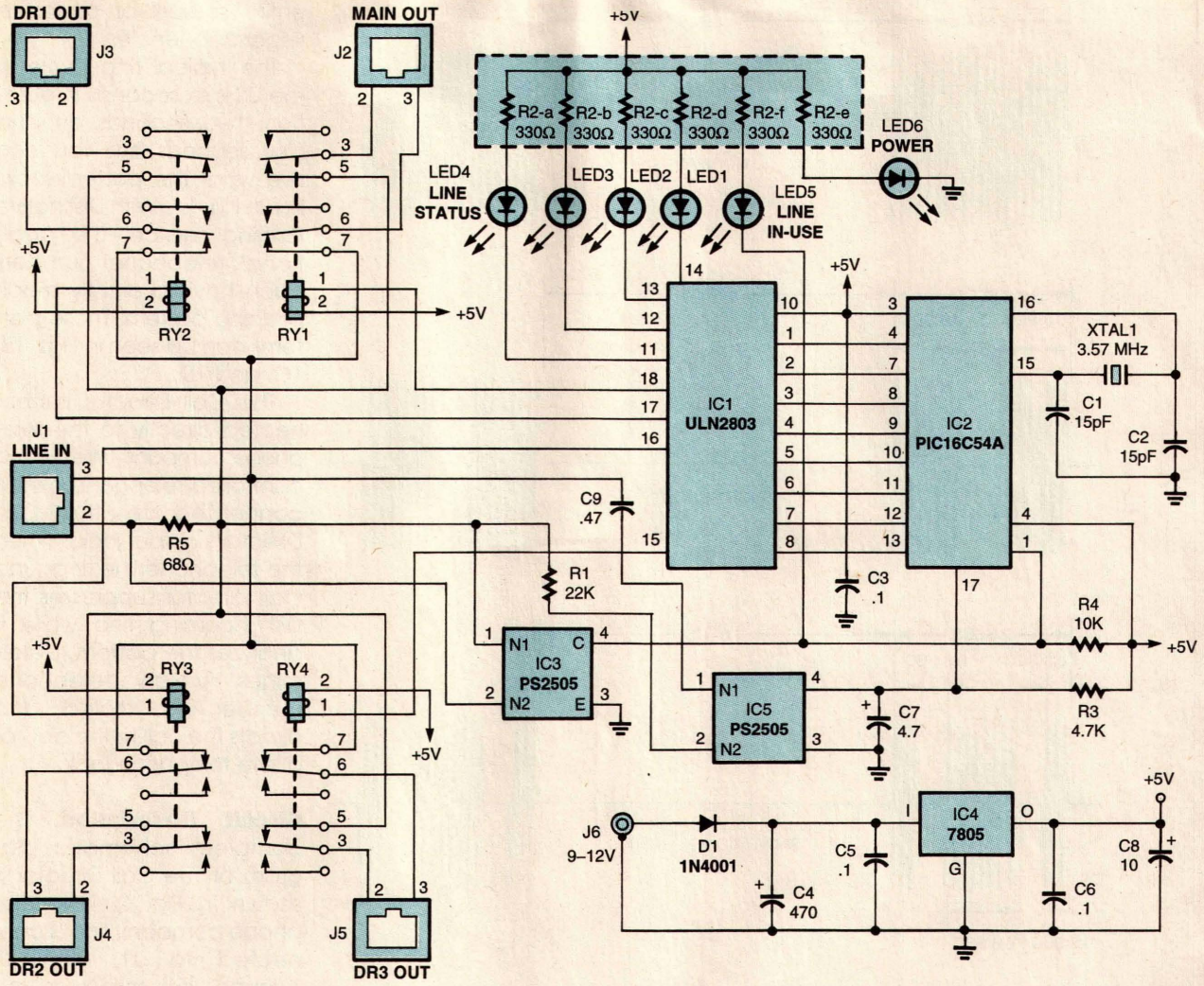


Fig. 2. The Call Director is built around a programmed microcontroller that notes the ring pattern of an incoming call and routes it to the appropriate jack.

When an incoming ring signal is present, it is AC-coupled to IC5 by C9 with R1 limiting current through the optoisolator. The value of R1 was chosen to guarantee that enough current flows to activate IC5 at the lowest ring voltage and frequency.

The resulting digital signal from IC5 is sent to IC2, an inexpensive PIC16C54A microcontroller that is the heart of the Call Director. As soon as an incoming ring signal is detected, IC2 activates RY1–RY4 through Darlington transistor array IC1; with no telephones connected through to J1, the first ring is suppressed. The ring pattern is analyzed by IC2. Once the ring pattern has been determined, the appropriate relay is turned off; the connected device, be it a telephone, fax machine, answering machine, or modem, can then "do its thing." The corresponding port status indicator (LED1–LED4) is also turned on, indicating which line is active.

Once the call has been directed, IC2 waits either for the ring signal to stop or for the telephone line to go off hook. If the ringing stops (the call was not answered and the calling party has hung up), RY1–RY4 are deactivated, reconnecting each line for outgoing access; the port status LEDs are also turned off. If the call is answered, the Call Director waits for the line to return to an on-hook state for more than two seconds, indicating that the telephone call was terminated, before taking the same action as just described.

The final portions of the circuit that have not been mentioned up to now deal with the "care and feeding" of IC2. The microcontroller's clock frequency is set by XTAL1, an inexpensive 3.57-MHz colorburst crystal. Note that C3 is connected to pin 3 of IC2. That capacitor helps to ensure that IC2 resets and starts executing its internal program correctly when power is applied to the Call Director.

Power for the Call Director is supplied by a 9- to 12-volt DC wall adapter that is connected to J6; the voltage is regulated by IC4. Light-emitting diode LED6 indicates when the Call Director is powered up.

Software. The Call Director's "firmware" (software that is permanently "burned" into IC2's program memory) gives the Call Director its personality. On power up, the microcontroller initializes its RAM

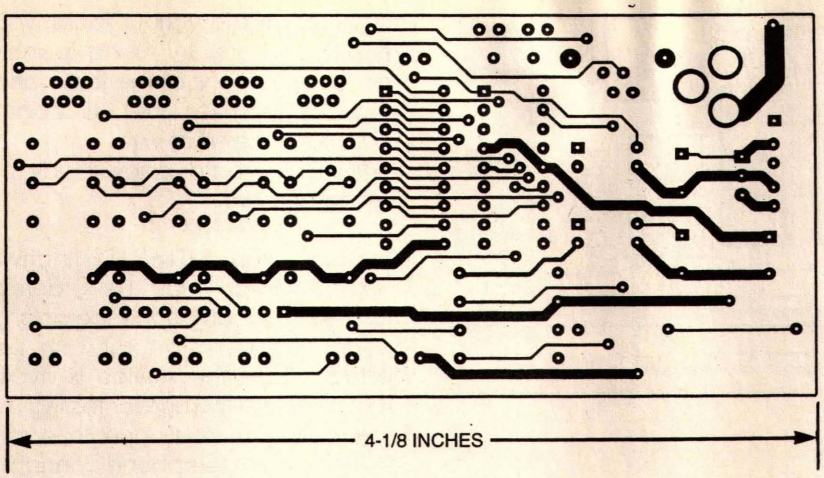


Fig. 3. Here's the foil pattern for the component side of the Call Director.

and cycles the port status LEDs. Following initialization, the program enters an idle state waiting for an incoming ring signal on pin 17.

As mentioned before, IC2 activates RY1–RY4 when an incoming ring signal is detected; the ring pattern is then sampled. A total of 32 samples are taken over the next two seconds. Those samples are analyzed to determine which output port should be reconnected.

Once the comparison has been made and the appropriate relay and status LED are enabled, the firmware starts a timer and enters an idle state. While in that idle state, the firmware monitors the outputs from IC3 (off hook) and IC5 (ring detect) on pins 1 and 17. As long as either signal is active, the timer is not decremented. If both signals ever go inactive together, the timer begins counting down. If it reaches zero, more than five seconds have elapsed without a ring signal or an off-hook condition. In that case, the firmware will reset the output relays and status LEDs, and then will wait for the next incoming ring signal.

If the off-hook signal goes low, indicating that the line was answered, the firmware enters a second idle state, waiting for the off-hook signal to return to the inactive state for more than two seconds. When that happens, the firmware acknowledges that the call has been terminated and releases all four relays; all four telephone lines are once again connected to the outgoing telephone line. After resetting the system variables, the firmware re-enters the idle state waiting for the next incoming ring signal.

Construction. The Call Director is

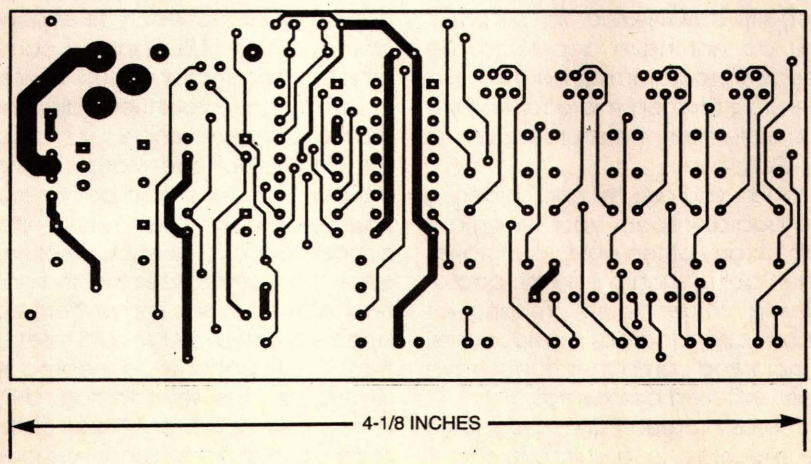


Fig. 4. Here's the foil pattern for the solder side of the Call Director. You'll need to use some method of connecting the traces between the two sides of the board.

PARTS LIST FOR THE CALL DIRECTOR

SEMICONDUCTORS

IC1—ULN2803 Darlington transistor array, integrated circuit
IC2—PIC16C54A microcontroller, integrated circuit
IC3, IC5—PS2505 bi-directional optoisolator, integrated circuit
IC4—LM7805 5-volt, 1-amp, fixed voltage regulator, integrated circuit
D1—1N4001 1-amp, 50-PIV silicon rectifier diode
LED1–LED4—Light-emitting diode, yellow
LED5—Light-emitting diode, red
LED6—Light-emitting diode, green

RESISTORS

(All resistors are 1/4-watt, 5% units, unless otherwise noted.)
R1—22,000-ohm
R2—330-ohm, 9-unit, 10-pin network, single-inline package
R3—4700-ohm
R4—10,000-ohm
R5—68-ohm

CAPACITORS

C1, C2—15-pF, ceramic-disc
C3, C5, C6—0.1-µF, ceramic-disc
C4—470-µF, 35-WVDC, electrolytic
C7—4.7-µF, 16-WVDC, electrolytic
C8—10-µF, 16-WVDC, electrolytic
C9—0.47-µF, 400-volt, polyester-film

ADDITIONAL PARTS AND MATERIALS

J1—RJ11 jack, PC-mount
J2–J5—RJ12 jack, PC-mount
J6—Co-axial power jack, PC-mount
RY1–RY4—Double-pole, double-throw relay, 5-volt coil, PC-mount
XTAL1—3.579545-MHz crystal
9-volt DC, 500-mA wall-mounted adapter, enclosure, hardware, wire, etc.

Note: The following items are available from: Custom Security Design, PO Box 116, Lawrenceville, GA 30046-0116; Tel: 770-682-1368 (voice or fax): Double-sided printed-circuit board with plated-through holes, $14.95; Preprogrammed and tested IC2, $14.95; Complete kit of all parts and AC adapter, $49.95. Please add $4.95 to each order for shipping and handling within the continental United States. GA residents must add appropriate sales tax.

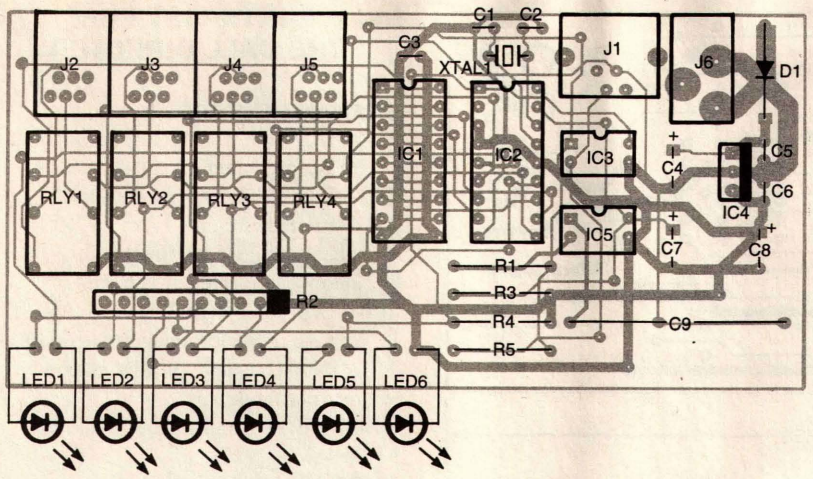
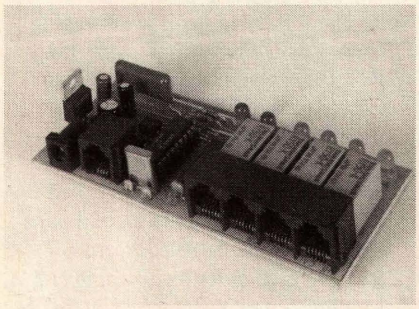


Fig. 5. All of the components for the Call Director fit neatly on a small PC board.

simple enough to be built on a piece of perfboard using standard construction techniques. However, using a printed-circuit board makes for a neater appearance as well as reducing wiring errors. Should you wish to use the PC-board construction method, foil patterns for a double-sided board are available in Figs. 3 and 4. Producing a double-sided board can be difficult for the home hobbyist; an etched and drilled board is available from the source given in the Parts List.

If you use the foil patterns provided here or a purchased board, use the parts-placement diagram shown in Fig. 5 for component location. Note that if you etched your own board, you will have to make some sort of provision for passing signals from one side of the board to the other where a solder pad is located on both sides of the board. Alternatives to plated-through holes include small eyelets and short pieces of wires. Where a component lead goes through the hole, you can use that lead for the connection. Keep in mind that in all of those suggestions, you will need to solder the connections on both sides of the board. The only "hard and fast" rule is that the method you use should be one that you are comfortable with and can reliably make a solid connection.



The completed Call Director is ready for mounting in a case and use. Note that in the author's prototype shown here, J2–J5 are a single "block" of jacks.

The only recommendation that we have in soldering the board would be to use a socket for IC2; software updates are easier to do when the microcontroller is not soldered directly to the board!

Before installing IC2, it must be programmed with the Call Director software. The software is available on the Gernsback FTP site at *ftp.gernsback.com/pub/pop/call_director.zip*. If you are unfamiliar with programming a PIC microcontroller, information and software for doing that are available at the manufacturer's (Microchip, Inc.) Web site at *www.microchip.com*. If you do not have access to the needed programming hardware, a pre-programmed microcontroller is available from the source given in the Parts List.

When you are finished soldering the board, inspect your workmanship for any of the obvious mistakes when doing such a project: bad or missing solder joints, missing or incorrectly located components, or polarized components that have been installed backwards.

The assembled PC board should be mounted in a suitable enclosure. If you have difficulty in mounting the PC board so that you can easily reach the various jacks, you might want to try using panel-mounted versions of the jacks and connect them to the PC board with short lengths of wire.

The Call Director is now ready for testing and use.

Testing and Use. Distinctive Ringing service must be ordered from your local phone company before the Call Director can be tested. Once the service is available, prepare the unit for testing by connecting a telephone to each of J2–J5; a fifth telephone connected to the outgoing line in parallel to J1 is also handy to indicate by its ringing what type of call is coming in.

Before applying power to the Call Director, lift the handset of each connected telephone separately and listen for a dial tone. If there is no dial tone at any of the ports, recheck the solder connections on the PC board to make sure that there are no solder bridges or cold solder joints. If the dial tone is missing at only one of the ports, verify the connection for that port. Look for soldering errors on the board in the vicinity of the faulty output port. You might need to check the relays.

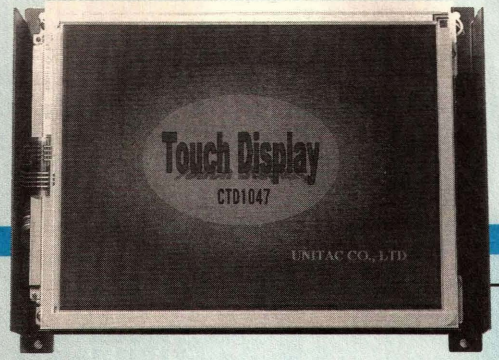
Testing the Call Director will require the use of a second telephone line; a cellular telephone or a friend at another location will do. Apply power to the unit; LED6 should light up and LED1–LED4 should cycle on and off momentarily to indicate that IC2 has powered up correctly. Once that test has passed, pick up each telephone one at a time; LED5 should come on indicating that the line is in use.

Dial (or have your friend dial) the main telephone number. As soon as the fifth telephone starts ringing, the Call Director should activate all four relays; the four telephones connected to J2–J5 should not ring while the unit analyzes the ring pattern. As soon as the ring pattern has been decoded, RY1 should reset so that the telephone connected to J2 rings on the second ring; LED1 should also come on. None of the other connected telephones should ring. Answer the ringing telephone

(Continued on page 32)

New Models with Newly Added Features!!

TOUCH DISPLAY MODULE



CTD1047 COLOR NEW

10.4-inch color TFT

CTD5741 COLOR NEW

5.7-inch color STN

Model in photograph enclosed in case. (CTD5741-11)
CTD5741 is 100% compatible with μTD4141.

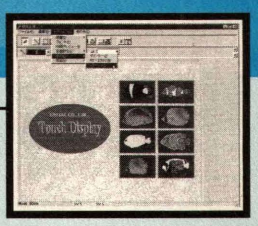
μTD4141

5.7-inch monochrome

Development Support Tool

For Windows 98/95

$150 NEW



New Features

Personalized Color Pallets

You can personalize the tone of the built-in 16-color pallet by setting RGB (brightness) level.

Copying

Areas of the screen can be selected and copied onto other screens.

Expanded Flash Memory

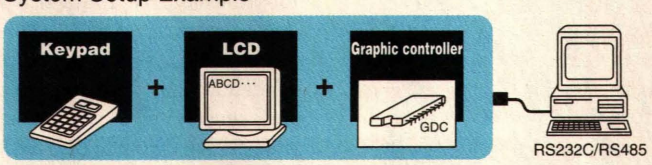
Image Manipulation

Images imported from digital cameras or other sources can be easily bitmapped and registered on screens or keycaps. (The demonstration fish was created with the Development Support Tool.)

Screen-to-Screen Group Move

Screen data can be selected, grouped and moved to other screens.

●System Setup Example



Specification \ Model		μTD4141	CTD5741	CTD1047
Display	LCD	5.7-inch, monochrome	5.7-inch, color STN	10.7-inch, color TFT
	Resolution	320 × 240	320 × 240	640 × 480
	Maximum digits	40 columns × 30 lines	40 columns × 30 lines	80 columns × 60 lines
	Effective display area (mm)	116 × 87	116 × 87	211 × 158
Key matrix input		10 × 6	10 × 6	13 × 10 (640 × 480)
Key size (mm)		12 × 14	12 × 14	15 × 15
Power supply		5V DC 0.8A	5V DC 1A	5V DC 1.2A
Dimensions (mm)		W189 × D112 × H32	W189 × D112 × H32	W272 × D205 × H43
Standard price		**$555**	**$740**	**$1225**

※Escutcheons and cases available for all models.

- Via RS-232C communications, simple commands let you easily display characters, draw graphics or collect key-input information.
- The built-in display memory can hold 4 full screens, making paging and other screen operations more convenient. (Up to 54 screens can be added with the Expanded Flash Memory.)
- Expansion features can be easily used with the Development Support Tool optional software.
- A wide array of characters can be displayed including kanji, kana, alphabet, numerals and special patterns.
- Key-input can be selected between polling and interrupt.
- Equipped with buzzer ON/OFF and backlight ON/OFF commands.
- Characters can be displayed as large as 64 × 64 dot.
- Easy backlight replacement (for color LCD models).
- Portrait monitor and RS485 model are available as special specification.

URL = http://www2.dango.ne.jp/onomichi/inh/

E-mail = inh@orange.ocn.ne.jp

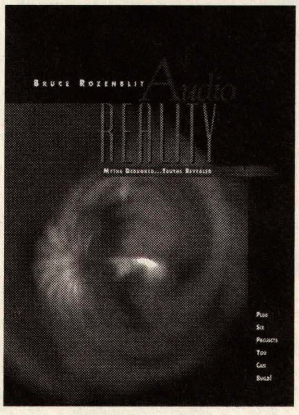
INH International Hanbai Co., Ltd
22-30 Kanda-cho, Onomichi, Hiroshima, 722-0016, Japan

NEW LITERATURE

Audio Reality: Myths Debunked . . . Truths Revealed

by Bruce Rozenblit
Transcendent Sound, Inc.
7244 Madison
Kansas City, MO 64114
Tel: 816-333-7358
Web: www.transcendentsound.com
$29.95

Written for the novice, the book provides basic electronics theory for the audiophile. Using simple analogies, clear explanations, and no math, the author presents the science behind audio devices. Topics include: conductors, connectors, skin effect, impedance, interconnects, speaker cables, balanced lines, transmission lines, power cords, isolation transformers, damping systems, feedback, acoustics, and more.

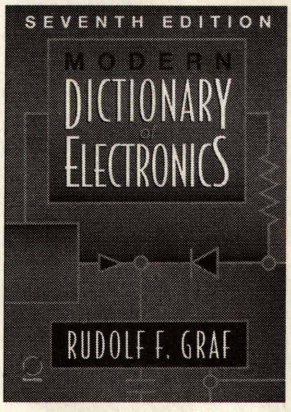


It emphasizes getting people involved with electronics through building their own equipment. Six projects are included—actual designs of the Transcendent Sound product line —that readers can build. Complete schematics and circuit explanations are provided.

Modern Dictionary of Electronics, Seventh Edition

by Rudolf F. Graf
Newnes, Butterworth-Heinemann
225 Wildwood Avenue
Woburn, MA 01801
Tel: 800-366-2665 or 781-904-2500
Web: www.newnespress.com
$59.95

Completely updated, this comprehensive dictionary contains over 28,000 electronic terms, phrases, acronyms, and abbreviations from the ever-expanding worlds of consumer electronics, optics, microelectronics, computers, communications, and medical electronics. All the definitions are clearly and simply presented, and hundreds of illustrations accompany the text.



This dictionary is a valuable resource for professionals in the field, hobbyists, students, or anyone interested in electronics. For easy reference, the author has provided definitions for standard abbreviations and equations, as well as tables of SI (International System of Units) units, measurements, and schematic symbols.

Microcontroller Projects with Basic Stamps

by Al Williams
R&D Books
Miller Freeman, Inc.
1601 W. 23rd Street, Suite 200
Lawrence, KS 66046
Tel: 800-500-6875 or 785-841-2047
Web: www.rdbooks.com
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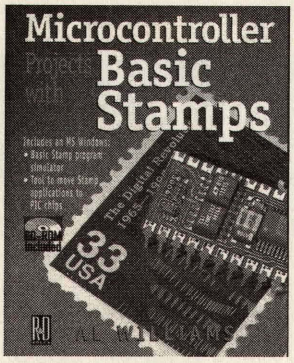
Free catalogs are *not* available.

This is a complete guide to developing practical solutions with the Basic Stamp. There are clear explanations of the principles needed to design hardware and write software for this microcontroller. A wealth of example projects and a Basic Stamp emulator lets readers experiment with this device.



Sample projects include a PC-connected frequency counter, a homebrew analog-to-digital converter, a resistance or capacitance meter, a Morse code keyer, and a variety of illustrative games. The included CD-ROM is packed with files and information about the Stamp.

Robot Store Catalog (Number 17)

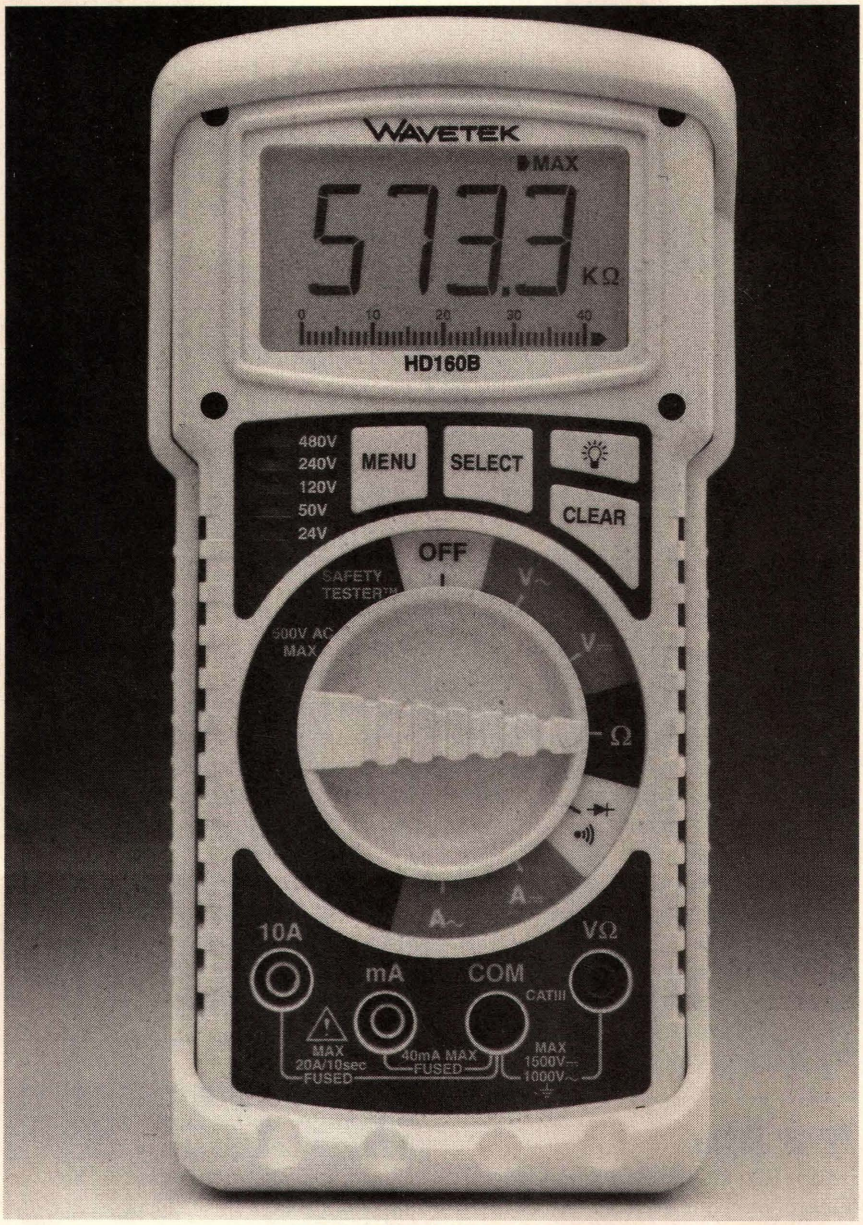
from Mondo-tronics, Inc.
PMB-N, 4286 Redwood Highway
San Rafael, CA 94903
Tel: 800-374-5764 or 415-491-4600
Web: www.RobotStore.com
Free

Meant for educators, engineers, and electronics hobbyists, the latest catalog includes all types of robots and robot kits. These include robots that listen, touch, and see; programmable robots; and wheeled platforms. Among the new products are the Lego Mindstorms Droid Developer Kit, the dual processor Descartes robot, and the Cye robot.

The catalog begins with a helpful guide to robots to build at different age and skill levels, ranging from the basic Hyper Preppy to their most advanced Rug Warrior Pro Kit. In addition to kits, the catalog includes robot parts, platforms, muscle wires, BASIC stamps and boards, and books and videos featuring robots. P

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Digital Multimeter



CIRCLE 60 ON FREE INFORMATION CARD

DESIGNED FOR CONTINUOUS USE in the toughest and most demanding field service environments, the Model HD160B is a heavy-duty autoranging multimeter. It is resistant to damage from water, fluids, dust, dirt, chemicals, voltage transients and spikes, and is drop-proof from over 10 feet. The meter is ideal for electricians, industrial plant engineers, HVAC/R technicians, commercial building maintenance staff, power utilities field staff, and other service jobs.

The case is made of special high-resilience plastic and a rubber boot is provided for extra protection. Every input jack is extensively fused and protected from accidental damage (extra fuses are included). All openings, including case halves, screw-holds, keypads, and input jacks, are gasketed and sealed.

The meter features 10,000-count resolution, 1500-VDC measuring range, and a backlit display with oversized characters. It measures voltage and current, AC and DC, resistance, continuity, diode test, and checks for live voltages. Among its other features are menu-selectable probe/max/min reading hold and differential reading, high-voltage alerts, thirty-minute auto-off, and premium test leads. A tilt-stand and Flex-strap are also included.

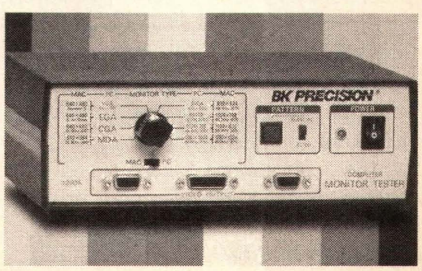
The Model HD160B digital multimeter has a suggested retail price of $199.95.

WAVETEK WANDEL GOLTERMANN, INC.
9145 Balboa Avenue
San Diego, CA 92123
Tel: 858-279-2200
Web: www.wwgsolutions.com

Computer Monitor Pattern Generator

DESIGNED FOR SERVICE TECHNIcians to use in bench-top test or multiple monitor burn-in applications, the Computer Monitor Pattern Generator (Model 1280A) is ideal to test both PC and Mac monitors. The unit enables users to conduct operational and evaluation tests using crosshatch or dot pattern, color bars, window and raster patterns, in red, green, blue, black, and white. Setting the Auto Manual Switch to AUTO allows the output to automatically cycle through all patterns.

Packaged in a compact 3⅛ by 9⁷⁄₁₆ by 9¼-inch bench-top enclosure, the



CIRCLE 61 ON FREE INFORMATION CARD

Model 1280A works with both interlaced and progressive monitors and tests CGA, EGA, VGA, SVGA, and Mac monitors. Additional features include single push-button selectable patterns and multiple monitor testing or burn-in. Convenient front-panel controls and indicators include the Power ON/OFF slide switch, LED Power ON Indicator, System Type Switch (selects Mac or PC), Monitor Type Selector Switch, and step-through Video Pattern Switch.

The Computer Monitor Pattern Generator (Model 1280A) has a suggested retail price of $399.

B&K PRECISION CORP.
1031 Segovia Circle
Placentia, CA 92870
Tel: 714-237-9220
Web: www.bkprecision.com

Insulation Tester

THE INSULATION TESTER (MODEL 380365) performs insulation resistance measurements in four ranges up to 4000 megohms and ±3% basic accuracy. It also measures up to 600 volts AC. Measurements are displayed on a 4000-count backlit LCD with Data Hold and 50-segment analog display. Data can be collected via the RS-232 PC interface and Windows-compatible data acquisition software.

CIRCLE 62 ON FREE INFORMATION CARD

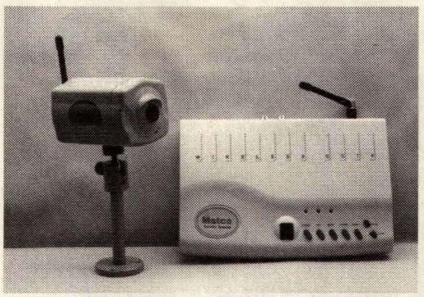
Features such as low resistance tests, audible continuity, test lock function, and automatic zero function make this tester very useful for regulatory compliance testing, appliance safety, and wire and cable testing. The meter comes complete with test leads, alligator clips, RS-232 PC cable, software diskette, neckstrap, and 8 AA batteries.

The Insulation Tester (Model 380365) has a suggested retail price of $449.

EXTECH INSTRUMENTS CORP.
335 Bear Hill Road
Waltham, MA 02451
Tel: 781-890-7440
Web: www.extech.com

Wireless Surveillance System

COMBINING STATE-OF-THE-ART performance, with an easy wireless setup, the AS-1004 Wireless Surveillance System operates on a 2.4 GHz frequency for sharp, interference-free images and sounds. It has a range of 300 feet in a home/office setting, which can be increased if an optional patch antenna is used.



CIRCLE 63 ON FREE INFORMATION CARD

The system has audio capabilities and can be expanded to monitor up to four cameras simultaneously. Each camera operates on its own separate noise-free FM channel, has a built-in 3.6mm wide-angle lens, with 400 TV lines of resolution. The system includes a transmitter, receiver, camera, power adapters, complete mounting hardware, and color-coded video and audio plugs for monitor or VCR hookup.

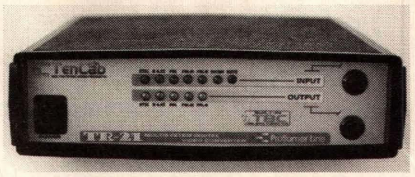
The AS-1004 Wireless Surveillance System has prices starting at $169.

MATCO, INC.
830 East Higgins Road, Suite 111-P
Schaumberg, IL 60173
Tel: 800-719-9605
Web: www.mat-co.com

Power Supply

THE RA CONSTANT VOLTAGE Linear Power Supplies are designed for the lab bench or for various system applications. They are full-range, adjustable laboratory power supplies, which provide the option of dual analog or digital meters. The availability of RS-485 and RS-232 programming options makes the RA series a versatile test instrument.

Features include less than 1mV ripple, remote programming and sensing, and series/parallel operation. The full rack-size unit has 10-turn voltage control, current limit control, series/parallel operation, and fast response time. Models include maximum voltages of 20, 40, 60, 125, and 250 VDC.



CIRCLE 64 ON FREE INFORMATION CARD

The RA Constant Voltage Linear Power Supplies have prices ranging from $1433 to $4650.

MID-EASTERN INDUSTRIES
100 School St.
Bergenfield, NJ 07621
Tel: 201-385-0500
Web: www.mideastind.com P

CALL DIRECTOR

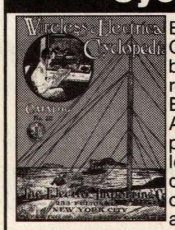
(continued from page 28)

and verify that the call connection has been made. Verify that lifting the handset of each and listening disables the other telephones.

Hanging up the telephone connected to J2 should turn off both LED1 and LED5. All of the relays should deactivate so that you can place outgoing calls. The test should be repeated for each additional Distinctive Ringing telephone number that you have subscribed to. As each additional telephone line is tested, the appropriate LED and relay should activate.

Once the Call Director is working correctly, simply wire the telephones as needed to the unit and sit back as you enjoy your first tastes of 21st-Century telephone service! Ω

Wireless & Electrical Cyclopedia



ETT1—Wireless & Electrical Cyclopedia $4.99. Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.To order ETT1, send **$4.99 (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA11

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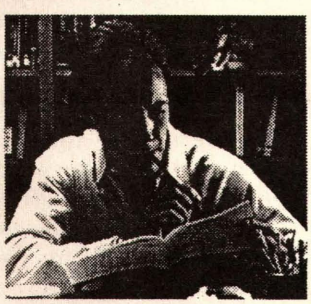

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Service Clinic

SAM GOLDWASSER

VCR Troubleshooting and Tape Transport

This month we'll go inside a VCR, including some troubleshooting tips and a description of a typical VHS transport. But first, let's make sure that you understand the safety issues—though there aren't nearly as many dangers inside a VCR as a microwave oven or TV.

Safety

Once you remove the cover(s) of a VCR (ignoring the warnings about "no user-serviceable parts," etc.), there are some risks to you and your VCR. You also, of course, void the warranty (at least in principle). Therefore, if the unit is still under warranty, having it serviced professionally might be your wisest option.

Stay away from the line side of the power supply; put electrical tape over the exposed connections. To be doubly sure, tape a piece of cardboard or thick plastic over the power supply section. Other than that, there is more danger of damaging the VCR by accidentally shorting something out or breaking a little plastic "doodad" than of getting hurt.

Since most VCR problems are mechanical (you probably won't even need to get out a multimeter), there really isn't much more to it! However, take care if circuit boards need to be moved out of the way; see the general safety information in previous "Service Clinic" articles or at my Web site if probing or other more involved intervention is needed.

Troubleshooting Tips

Many problems have simple solutions. Don't immediately assume that your problem is some combination of esoteric, complex, and convoluted failures. For a VCR, it might just be a bad belt or an experiment in rock placement by your three-year-old. Try to remember that the problems with the most catastrophic impact on operation (a VCR that eats tapes) usually have the simplest solutions (replace the idler tire). The kinds of problems that we would like to avoid at all costs are the ones that are intermittent or difficult to reproduce: the occasional interference or a VCR that sometimes will not record your favorite soaps on alternate Thursdays before a full moon.

If you get stuck, sleep on it. Sometimes, just letting the problem bounce around in your head will lead to a different (read "more successful") approach or solution. Don't work when you are really tired. That is dangerous, mostly non-productive, and possibly destructive.

Whenever working on precision equipment, make copious notes and diagrams. You will be eternally grateful when the time comes to reassemble the unit. Most connectors are keyed against incorrect insertion or swapping of cables, but not always. Apparently identical screws might be of differing lengths or have slightly different thread types. Little parts might fit in more than one place or orientation. The list goes on and on.

Pill bottles, film canisters, and plastic ice-cube trays come in handy for sorting and storing screws and other small parts after disassembly.

Select a work area that is well lighted and where dropped parts can be located—not on a deep-pile shag rug. Something like a large plastic tray with a slight lip can come in handy as it prevents small parts from rolling off the worktable. The best location will also be relatively dust free and allow you to suspend your troubleshooting to eat, sleep, or think without having to pile everything into a cardboard box for storage.

Another consideration is Electro-Static Discharge, or ESD. The electronic components in a VCR are vulnerable to ESD. There is no need to go overboard, but taking reasonable precautions such as getting into the habit of touching the chassis first before any of the electronic components is a good practice. The use of an antistatic wrist strap is further insurance.

A basic set of precision hand tools will be all that you need to disassemble a VCR and perform most adjustments. They do not need to be really expensive, but poor quality tools are worse than useless and can cause damage. Needed tools include a selection of Philips and straight-blade screwdrivers, needlenose pliers, wire cutters, tweezers, and dental picks. A jeweler's screwdriver set is a must particularly if you are working on a portable VCR or camcorder. For adjustments, a miniature ($^1/_{16}$-inch blade) screwdriver with a non-metallic tip is desirable. It prevents the presence of metal from altering the electrical properties of the circuit (those who work on older TVs and radios are familiar with that concept) and minimizes the possibility of shorting something from accidental contact with the circuitry.

You should not need any VCR-specific tools with the possible exception of a miniature metric hex-key wrench set for loosening the set screws on the roller guides should you need to perform a tape-path alignment. I have never needed a VCR head puller. You can make a tool for the special nut found on many A/C head assemblies for tracking adjustment by filing a slot in the blade of a straight-blade screwdriver.

A low-power, fine-tip soldering iron and fine rosin-core solder will be needed if you should have to disconnect any soldered wires (on purpose or by accident) or replace soldered components.

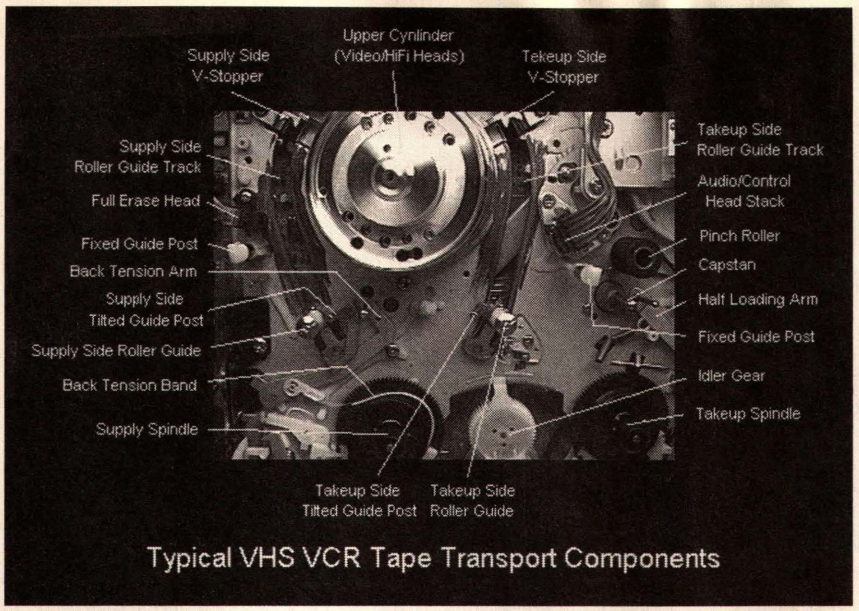

Fig. 1. A typical VHS VCR tape transport mechanism. Note that this particular system uses gears to drive the tape spindles. (Photo courtesy of Brian Siler.)

For thermal or warmup problems, a can of "cold spray," "circuit chiller," or other component cooler and a heat gun or blow dryer come in handy to identify components whose characteristics might drift with temperature. Using the extension tube of the spray can or making a cardboard nozzle for the heat gun can provide very precise control to identify the problem components.

Basic cleaning supplies include cotton swabs for everything *but* the video heads (use chamois-covered cleaning sticks on them), lint-free cloths or paper towels, water, and isopropyl alcohol—preferably 91% medicinal grade or better.

If you have several VCRs or do repairs for friends (hopefully not soon-to-be former friends!), there are inexpensive kits of VCR mechanical parts such as washers and springs that come in handy. General belt or similar kits are not worthwhile unless you are in the service business. There is too much variety in the sizes and other characteristics of those types of parts to make an assortment a good investment.

Test Equipment

Don't start with electronic test equipment; start with some analytical thinking. Many problems associated with consumer-electronic equipment do not require a schematic, though one can be useful. The majority of problems with VCRs are mechanical and can be dealt with using nothing more than a good set of precision hand tools, some alcohol, degreaser, contact cleaner, light oil and grease, and your powers of observation along with a little experience. Your built-in senses and that gray stuff between your ears represent the most important test equipment you have.

A DMM or VOM is necessary for checking power-supply voltages and testing sensors, LEDs, switches, and other small components. Unless you get deep into the electronic repair of VCRs, an oscilloscope is not needed.

There are two items of important test equipment that you probably already have:

A video-signal source for both RF and baseband (RCA jacks). Unless you are troubleshooting tuner or video/audio-input problems, either one will suffice. RF sources include a pair of rabbit ears or an outdoor antenna, a cable connection, or a VCR with a working RF modulator. Similarly, a working VCR makes a handy baseband or RF signal source.

A display device. A video monitor or TV makes an excellent video-signal display. Many video problems can be diagnosed by just examining the picture. An old TV with a vertical-hold control is useful when adjusting back-tension, should the need arise. A black-and-white TV is adequate for many of the tests that you will do.

Cassette Cheaters

When troubleshooting mechanical problems in a VCR, one of the handiest accessories is a cassette cheater: a frame to fool the VCR into thinking that there is a cassette in place so that you have access to the reel spindles and idler.

You can buy them for $6-12, but you can make one that is almost as nice:

Take a discarded cassette, open it up, and throw away everything but the top and bottom halves and the screws.

Punch out the plastic windows—and somewhat more of the top and bottom if you are so inclined; relatively little of the original structure is actually needed to fool the VCR! The more open the cheater is, the easier it will be to see and access the guts of the VCR while it is running.

Reassemble the two halves of the cassette with the screws—you did save the screws, right?

Put a bit of black tape over the sensor holes on the sides of the cassette near where the hinge pins of the flap went.

These cheaters will load and "play" just fine in most machines. Some machines actually sense that the supply reel is being turned by the tape movement and will shut down if it isn't (among other peculiarities), so you might have to do that by hand.

Test Tapes

When aligning the tape path, a test tape will be needed as a reference. Actually, you want two: one recorded at the SP (2-hour) speed and another recorded at the EP (6-hour) speed. They do not need to be exorbitantly-priced professional-alignment tapes. A couple of recordings made on a known working VCR will get you close enough for most purposes. Do not use those tapes for diagnosing or testing of mechanical problems; your VCR might be hungry and eat them.

For general video diagnosis including mechanical and tape-eating problems, a bunch of sacrificial tapes are handy. Advertising, promos, feature shorts or anything that you do not care about but have been recorded on working VCRs are fine. Very often they get mangled and you do not want to continue to use mangled tapes that might damage the VCR—in particular the video heads. However, once you have the VCR basically working, you will want to test it start to finish on a T120 cassette

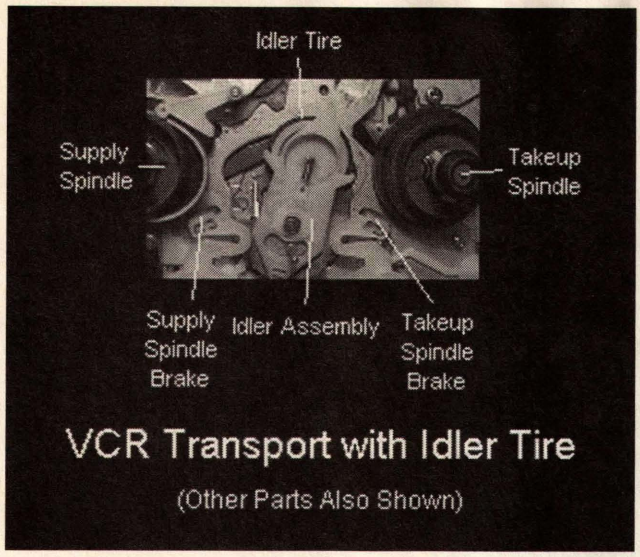

Fig. 2. This VCR mechanism uses an idler tire instead of gears. (Photo courtesy of Brian Siler.)

because the reel hub sizes might be different on those short tapes.

Getting Inside a VCR

As I mentioned before, you will void the warranty—at least in principle. There are usually no warranty seals on a VCR so unless you cause visible damage or mangle the screws, it is unlikely that this would be detected; you need to decide. A VCR still under warranty should probably be returned for warranty service for any covered problems except those with the most obvious and easy solutions.

It is usually very easy to remove the top and bottom covers on VCRs. For the top cover, there are usually some very obvious screws on the back or sides, and in rare cases on the top. There might be a couple of screws on the bottom as well that secure the top cover. For top loaders, you will probably need to remove the cassette holder lid. There will be two screws, perhaps hidden by rubber plugs.

Once all of the screws are out, the top cover will lift up or slide back and then come off easily. If it still does not want to budge, recheck for any screws that you might have missed.

For the bottom cover, there are usually a half dozen or so screws around its perimeter and sometimes in the middle as well. There might be one or two grounding screws as well that are of different length and threads; those should go back in the same location from where they came. Bottom covers are usually simple sheet metal. In rare cases, you will need to remove the front panel to free the bottom cover (or vice-versa).

Circuit boards might prevent access to the top or bottom of the tape transport. Usually, removal of a few screws (often marked with red paint or arrows on the circuit board) and perhaps pressing a couple of snaps will let the board swing up on a hinge out of the way.

Front panels usually snap off, possibly requiring the removal of a few screws on top or bottom.

Why Does My VCR Shut Down or Behave Strangely When I Remove The Cover?

There are various sensors in a VCR that are light sensitive. They are not safety interlocks (though they can act that way in some VCRs) but a result of the way that the tape start and end sensors work. VHS tapes have a clear leader and trailer. An LED or light bulb poking up near the center of the cassette point at sensors on either side of the cassette. When light is detected, the VCR assumes that it is at the appropriate end of the tape and shuts off (or rewinds if in PLAY mode) when it senses the end depending on model.

During servicing, a piece of cardboard or other opaque insulating material should be placed above the cassette basket if any strange behavior is detected that was not present with the cover in place. Not all VCRs are particularly sensitive to external illumination.

VCR Tape-Transport Fundamentals

Let's take a look at the parts of the tape transport in a VCR. (see Fig. 1) This applies to 99.9% of the VCRs in existence today. I can't say 100% because I have seen at least one that had a sideways-loading mechanism—very weird!

Looking at the unit from above with the front toward you:

Supply Spindle—Located on the left-hand side platform. The supply tape reel (inside the cassette) sits here.

Take-Up Spindle—Located on the right-hand side platform for the take-up tape reel (inside the cassette).

Idler—The assembly that swings between the supply and take-up reels, transferring power to the appropriate reel to wind the tape up during play and record and often to drive fast forward and rewind. This can use a rubber tire or a gear.

Idler Tire—The black rubber ring on the outside of one part of the idler that actually contacts the reel edges. This is the most likely part to need replacement after a few years of use. Some VCRs use a gear instead of a tire (as in Fig. 1), but the tire is the most common version, especially in older units. An example of a tire-based drive is shown in Fig. 2.

Roller Guides—There are two; one on each side. Those assemblies move from their retracted position toward the front of the machine (loaded position) for play and record. The white rollers should spin freely and be clean. When retracted, the roller-guide assemblies will be slightly loose. However, when the tape is wound around the video-head drum, they must be snug against the brackets at the end of the tracks (called "V-Stoppers"). Also on the same assembly are tilted metal guide posts; again, one for each side. Those posts sometimes fall out with obvious consequences. Proper functioning and adjustment of the roller guides is the most critical requirement for proper tracking.

Roller-Guide Tracks—A combination of plastic and metal slots in which the roller-guide assemblies slide during tape loading and unloading. Check to make sure that there is still some healthy grease on the surfaces.

Video-Head Drum or *Upper Cylinder*—This item measures about 2.45 inches in diameter by 0.75 inches high. This rotating assembly contains the video heads (and Hi-Fi audio and flying erase heads, if present).

Capstan—Located on the right side after tape exits from roller guide. The capstan is a shaft about 3/16 inches in diameter. It moves the tape forward or reverse during play, record, and search modes when the pinch roller is pressed against it.

Pinch Roller—A black rubber roller about 1/2 inch in diameter and 3/4 inch high that spins freely and presses against

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PC TECH

IMPROVING THE COMPUTER EXPERIENCE ... HANDS-ON

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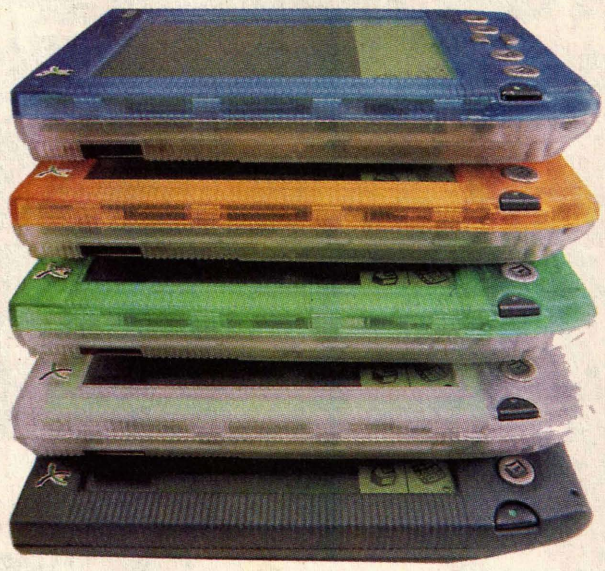
PC GIZMO®

Expandable Palm Computing



Want a pocket-sized device that can do, well, just about anything? As overly ambitious as it may sound, just such a device is available. Handspring, Inc.'s *Visor* (starting at $149) features a "Springboard" expansion slot that lets you plug in expansion modules ranging from MP3 audio players and digital cameras to pagers and wireless modems. Available in a variety of colors, the Visor may be the only computing device you need to bring with you.

Why the modules? The folks at Handspring realize that no one wants to carry about a dozen full-size electronic gadgets. Just carry your Visor PDA and whatever extras you need, only when you need them. A variety of vendors offer the modules, most of which are smaller than an audiocassette.

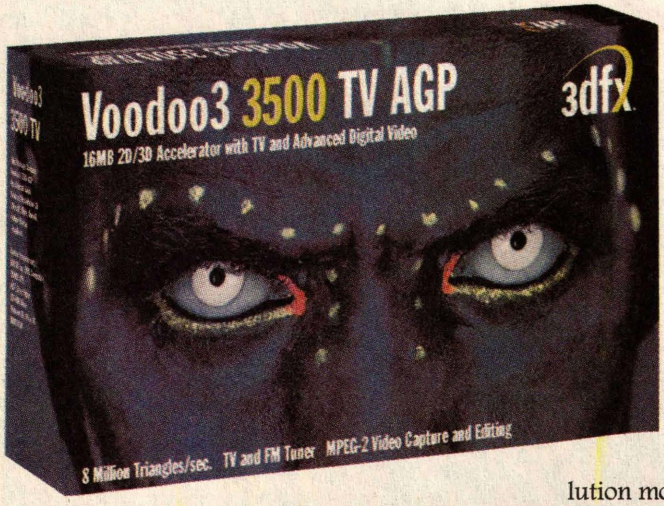
Hate typing by tapping on a screen with a stylus? There's even a foldout keyboard module available that closes to the size of a PDA, but opens to almost a full-size keyboard. Nice.

In addition to its available add-ons, the Visor is expandable with thousands of freeware and shareware applications, thanks to its Palm OS compatibility. For PC interfacing, you'll have to pick up a serial cradle with the standard, 2MB RAM version. If you buy the *Deluxe* version ($249), which has 8MB of RAM, you get a USB-interface docking cradle and leather case.

Handspring, Inc., 189 Bernardo Avenue, Mountain View, CA 94043; 888-565-9393; *www.handspring.com.*

CIRCLE 90 ON FREE INFORMATION CARD

Just Like Voodoo


Voodoo3 3500 TV AGP
16MB 2D/3D Accelerator with TV and Advanced Digital Video
3dfx
8 Million Triangles/sec. TV and FM Tuner MPEG-2 Video Capture and Editing

The idea of merging TV and PC video is not new—cards that let you capture and work with standard composite video have been around for years. However, they've never combined high-performance 3D graphics, DVD MPEG-2 recording and playback, and even FM radio reception before. Prepare to be amazed by the new age of multimedia; prepare for 3dfx's *Voodoo3 3500TV* ($250, street).

Ask most any gamer and he or she will tell you that the 3dfx Voodoo3 graphics accelerator is tops when it comes to realism and lightning-fast frame rates. Adding this technology to your PC alone would be worth the price of the 3500TV. But you get so much more.

Watch cable or satellite TV on your high-resolution monitor. Use the card's MPEG-2 support to play DVDs or make your own recordings of similar quality—imagine archiving junior's first steps this way until you can get a DVD recorder....

3dfx Interactive, Inc., 4435 Fortran Drive, San Jose, CA 95134; 888-FOR-3DFX; *www.3dfx.com.*

CIRCLE 91 ON FREE INFORMATION CARD

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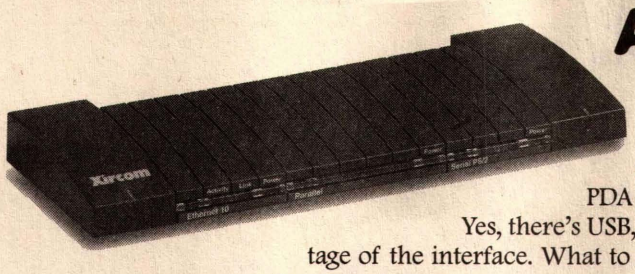
Add a Port ... or Seven



Got many expansion ports on the back of your PC? It seems you can never have enough. Add a Zip drive and a PDA docking cradle, and it seems your machine's clogged up. Yes, there's USB, but there still aren't enough USB peripherals to take advantage of the interface. What to do? Check out Xircom's *PortStation* ($169 and up, depending on configuration).

Thanks to PortStation, one USB port is all you need to add just about anything to your PC. The unit comes as two end caps that can connect up to seven port modules between them, all in a row. Add a four- or seven-port USB hub as one of the modules to avoid reaching behind your PC any more. Then decide what other ports you need and order them. Choose from parallel, serial, PS/2, 56-Kbps modem, Ethernet, and ISDN ports for now, with cable and ASDL modems soon to be released. With PortStation you get and pay for only what you want.

Xircom, Inc., 2300 Corporate Center Drive, Thousand Oaks, CA 91320; 800-438-4526; *portstation.xircom.com.*

CIRCLE 92 ON FREE INFORMATION CARD

A Cybernaut's Camera

When it comes to desktop digital cameras, most people only care about their video quality. But if you want a high-performance camera that also happens to look kind of on the cutting edge, and not just like an overgrown egg, only one unit will catch your eye. Dubbed the *USB RoboCAM* ($79, MSRP) it's LifeView's answer to dull-looking equipment.

The futuristic purple CAM will capture still images at up to 1024 × 768 resolution, with live-motion video coming in at 640 × 480 with excellent color quality. Motion video, depending on your computer and the complexity of the image you're shooting, can be up to 30 frames per second thanks to the RoboCAM's USB interface and progressive CODEC.

Coming with an abundant software bundle, the USB RoboCAM lets you videoconference, send video e-mail, edit movies, and touch up still shots, all right out of the box.

Lifeview, Inc., 46575 Fremont Boulevard, Fremont, CA 94538; 510-661-2968; *www.lifeview.com.*

CIRCLE 93 ON FREE INFORMATION CARD

Speech Recognition on the Go

If you drive a lot, or do a lot of walking, you may find yourself wishing you could make some productive use of that time. While microcassette recorders are handy for taking notes at such times, you'll be stuck with the chore of transcribing when you get back to the desk. Next time, bring along the *L&H Voice Xpress Mobile Professional* (about $200, street).

With the Xpress package, you'll not only capture what you say on an Olympus DS-150 digital recorder, but when you return to your PC, the device will transfer the audio to a handy program—*L&H XpressPad Mobile*—that will perform speech recognition on it. Imagine, all those notes and ideas will spring up on your screen like magic, while you kick back with a cup of coffee.

While recognition technology still isn't 100 percent (maybe every 15th word or so will be misinterpreted), chances are the amount of editing you'll have to perform will only be a fraction of the effort required to type in that "to-do" list or lengthy e-mail you composed on the drive to work. And it can even be a long drive, too, as the two-ounce DS-150 can store up to 75 minutes of speech.

Lernout & Hauspie Speech Products U.S.A., 52 Third Avenue, Burlington, MA 01803; 781-203-5000; *www.lhsl.com.*

CIRCLE 94 ON FREE INFORMATION CARD

SYSTEM DESIGN

TED NEEDLEMAN

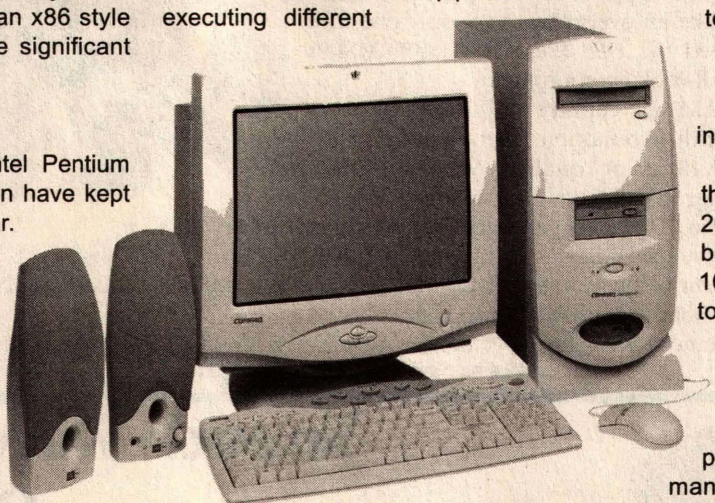
Compaq Presario 5868

In the spotlight this month is Compaq's Presario 5868—with a veritable panoply of design features. At the top of the list is the CPU it is based around, an AMD Athlon running at 600 MHz. Originally slated to be called the K7, the chip was renamed when AMD had a change of heart. And as Intel did when it named the 80586 CPU the Pentium processor, AMD decided to also give its newest offering a name. Fancy name or not, the Athlon is still an x86 style of CPU, albeit with some significant updates.

THE CHIP INSIDE

In many ways, the Intel Pentium family and the AMD Athlon have kept pace with each other. That's really necessary, if you think about it, as the AMD processor must maintain close compatibility with the Intel CPUs in order to avoid massive software incompatibilities. Where the two lines of CPUs diverge considerably is in the extended instruction sets. True, the AMD processor maintains compatibility with the MMX instruction set that Intel added to the Pentium after its initial release, and just about all of the software applications that have incorporated MMX instructions into the code mix will run just fine on AMD-based systems. However, to "one-up" Intel, AMD introduced further extended instructions into its K6-2 processor, which it named "3DNow!". Intel retaliated with the superset of KNI instructions it introduced with the Pentium III family. The KNI and 3DNow! Extended instruction sets are not compatible or equivalent, and producers of graphics software have, to a large degree, pretty much ignored both, though video-card vendors do try and incorporate support for both into their Windows drivers.

As with the Pentium, Pentium II, and Pentium III (as well as its previous K6-2 and K6-III processors), the Athlon features a superscalar, super-pipelined microarchitecture. Super-pipelined means that the CPU contains different execution pipelines for executing different types of CPU instructions. The Athlon has nine pipelines, three each for executing integer instructions, floating-point instructions (including MMX and 3DNow! Instructions), and address-calculation instructions. These instructions can be executing simultaneously in the different pipelines. The Athlon also has a somewhat more elaborate, and larger, cache architecture. The L1 cache, contained internally on the chip die, is 128K, and the L2 cache can be as small as 512K to as large as 8MB.



Most different, however, from previous AMD and Intel CPUs, is the type of socket required on an Athlon motherboard, as well as the system bus speed. The Athlon uses a "Slot A" socket, which is actually a socket developed for the DEC (now Compaq) Alpha Processor. Also borrowed from the Alpha system design is the Athlon's 200-MHz system bus speed, which will eventually be scaleable to 400-MHz. Unlike the new Intel Pentium IIIB CPUs, which incorporate .18-micron technology, the Athlon uses current .25-micron fabrication technology and contains approximately 22 million transistors.

Our Compaq Presario 5868 incorporates a 600-MHz version of the Athlon, and the motherboard runs with a 200-MHz front-end system bus, twice that of the typical 100-MHz bus on most of today's PCs, and faster even than the 133-MHz bus speed the newest Intel Pentium IIIB processors support. That combination punches up the performance considerably, though not to the extent that you might suppose from the 200-MHz system bus, since the components, including the PC100 type RAM, connected to the bus still run at the same speed they do in a system with a slower system bus. Overall, depending on the benchmark you choose, you will see between a 10- and 25-percent performance differential against a similarly configured 600-MHz Pentium III system.

BUT WAIT, THERE'S MORE....

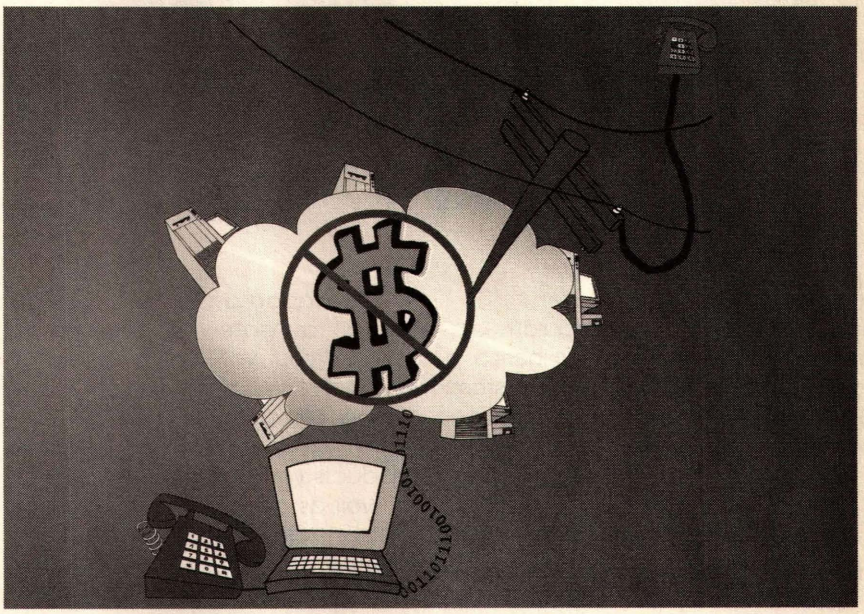
As interesting as the Athlon processor is, it's not the only design feature

(Continued on page 46)

Internet Telephony—The Next Generation

SELINA KYLE

The new breed of Net-phone products has arrived, bringing with it better quality and ease of use.



For about four years now, Internet telephony has been offering the promise of free long-distance calls to anyone with a Net connection and the appropriate software. That's right ... free long distance. So what happened? Why are you still seeing commercials for all sorts of calling plans from AT&T, Sprint, and a horde of lesser-known companies?

It's simple, really. The first generation of Internet telephony or Voice over Internet Protocol (VoIP) had serious problems.

For one, the technology came out at a time when not everyone was "connected." This limited its use as you couldn't, at the time, use a VoIP package to call someone without a computer.

Another problem was the sound quality. Echoes and delays abounded in most systems. Phone calls often ended up sounding more like AM radio interference than a chat with your cousin. This was only made worse by Net congestion.

Further, sitting at a computer with a headset and microphone just wasn't a convenient, natural way to make a call. Even though a few telephone-handset add-ons were invented, you never really enjoyed the convenience of picking up a phone, and making a natural call, which results in....

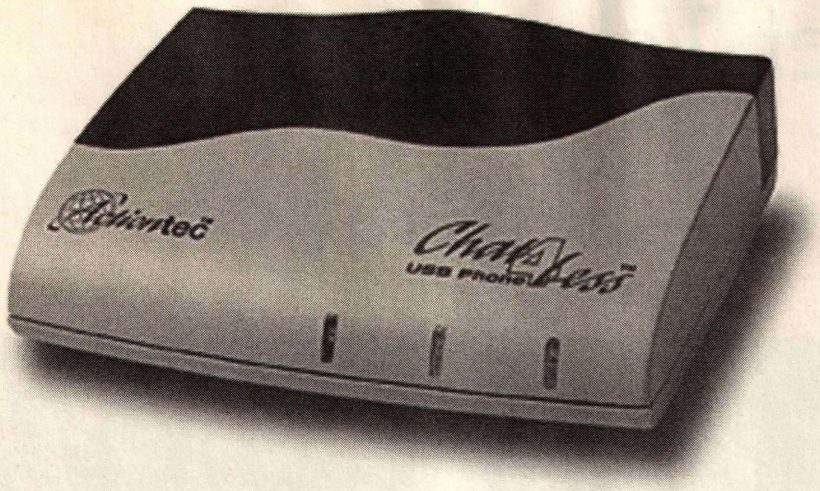
Hearing a phone ring. This simple thing we take for granted—it was conspicuously absent from most VoIP solutions. These systems had you agreeing on a time to meet at an Internet phone chat room so that one of you could select the other as the recipient of a phone call. Sure. What a great way to spontaneously call your parents in another state to tell them that they're now grandparents.

For all its potential, that first, long-lasting (at least for the computer industry) generation went the way of Beta videotapes, Philips digital audiocassettes, and other technologies that just couldn't capture high-tech consumers.

Enter the New Batch. What separates VoIP from our just-mentioned examples of failed ideas, however, is that Internet telephony had no competition. While people hated having incompatible video or audio formats (even if Beta videotapes and digital audiocassettes were superior), no one is opposed to the idea of saving a buck with Net calls. Though the enigmatic Phone Company might have strong opinions otherwise, VoIP is indeed a good idea—just one executed poorly at first.

But we all learn from our mistakes, and some truly innovative companies have devised a new batch of VoIP products. This time, however, engineers considered the quality and general atmosphere of a traditional phone call, and their resulting creations are very good. Dare we say almost equal in quality to regular telephones? That's a subjective estimation. Perhaps it's safer to say these new products provide you with at least modern cell-phone quality, if not better.

The reason for the success? Designers realized the problems associated with first-generation VoIP were almost impossible to eliminate without hardware solutions. Sure there were some hardware products in the past, but they didn't really help. For instance, as attractive as they were, those aforementioned first-generation handset devices were just repackaged computer speakers and microphones that didn't improve call quality. It was time to bring in some hardware that actually did



Chat4Less connects to your PC's USB port and lets you use a standard telephone to make calls over the Net.

something.

As a result, circuit and software combos were designed to increase data compression, so a VoIP system could send a higher-quality audio packet over the Net in the same speed at which lower-resolution packets used to travel. And when this better signal gets to the other side, it's now processed by echo-cancellation circuits and software, resulting in a more natural-sounding call all around. Add error correction to the mix, and the result is the new breed of VoIP.

We're also impressed with the way the new devices can work together. While several first-generation Net phone packages or programs could only make calls to identical ones (that is, to products from the same company), modern VoIP devices work with the H.323 interoperability standard. This means you can buy what you want and still talk for free to those who didn't buy the same product.

Note that for true "free" calls, your recipient will still have to have a Net connection and similar hardware as you. This means that if he or she doesn't have an online-all-the-time computer such as one with a cable or ADSL modem, you will still have to make some arrangements for chat times. However, you can also do away with all this and call any phone anywhere for low, per-minute fees that make it worth the effort of turning on your computer or dedicated VoIP device. These Net-to-standard-phone systems rely on a "gateway" provider to convert your VoIP call to a regular one in the city of the person you're calling. More on this later.

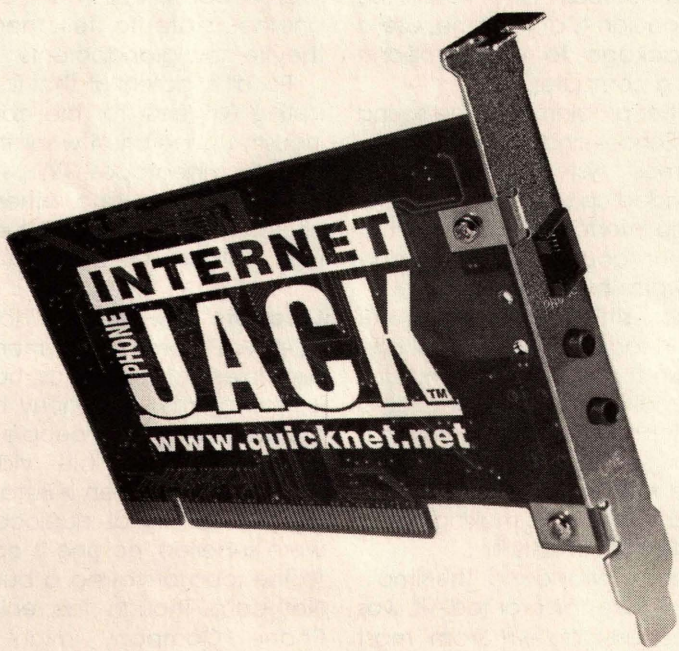
Join us now for a look at some products you can add to your PC, as well as a tried-and-true service that charges a modest fee to let you do away with hardware on both ends of a VoIP call (by the way, "tried-and-true" in this case means the author's been using this service for a couple of years).

Plug 'em in. *Action*tec has long been a computer communications innovator. Its modems have always performed well, including a recent call-waiting model we were impressed with (see last month's *PC Gizmo*). This time they wowed us with a brand-new device that we had to see in private at Comdex, the computer trade show in Las Vegas.

The *Chat4Less USB Phone* ($149, MSRP) does just about everything we've been bragging about so far—it is, in fact, the epitome of the new generation in VoIP. First of all, you can't find an easier installation than this. Just install the included *Chat4Less Communications Software* and connect the device to an open USB port. System requirements are modest. Basically, if your computer can support USB, it can work with Chat4Less (we recommend you have Windows 98 or NT 4.0 or higher for best results).

Once the device is connected to your computer, you get to do something wonderful and much anticipated. Believe it or not, you get to plug in your own, standard telephone into Chat4Less. Then use your PC to dial into the Internet as usual, either through a modem, LAN, or broadband connection, and prepare to make your first call.

And you already know how to



Install Internet PhoneJACK-PCI in your computer, plug a telephone into the card, and prepare to say goodbye to long-distance bills.

If you'd rather not use a computer for VoIP calls, check out IPStar—a standalone device that handles all aspects of Internet telephony.

make that call. Just pick up the attached phone and dial the number of a contact, friend, or loved one. They probably won't even know you're calling over the Internet. You have to hear for yourself just how good compression and echo-cancellation technology has gotten.

As implied earlier, this works with a gateway provider. The company, Net2Phone, which we'll examine more later on, provides the conversion from IP to local PBX for about 3.9 cents a minute. A terrific savings over even the best of TV commercial offers. For truly free calls, make sure your loved one is online with his or her own VoIP, be it Chat4Less or one of the following gadgets.

A product that's similar to Chat4Less is *Internet PhoneJACK-PCI* ($159) by Quicknet. Also using enhanced data compression and echo cancellation, the Internet PhoneJACK can provide high-quality calls over the same protocol that first-generation, software-only solutions couldn't quite handle.

The major difference from Chat4Less is that you'll have to open up your PC to install Internet PhoneJACK-PCI. As its name implies, the product is a PCI card, and as such your machine will have to have a free slot to accommodate it. Other than that available slot, the only other requirements are a machine that can run Windows 95, 98, or NT, or even Linux.

The PhoneJACK-PCI coexists with your sound card in your machine to provide its own duplex-audio send and receive functions. Plug a standard telephone into the jack on the card, and speak as you normally would into the handset. The software and hardware takes care of the rest.

For cost-free calling, use the device with someone's ICQ (a phonetic shortening of the phrase "I seek you"). An ICQ number is kind of like an instant-messaging username in that it lets someone "page" or contact you when you're online. If the recipient is online, he or she can use any VoIP device to talk with you. This is because PhoneJACK-PCI, like Chat4Less, can work with any H.323-compliant software.

Now, should the person you're calling actually not be at the computer (can you imagine?), PhoneJACK can also call a regular phone number. The same gateway charges previously mentioned apply.

Standalone Hardware. While this is the PC Tech section, there's nothing wrong with mentioning a device that uses the Internet yet doesn't work with a computer. In a way, this device is a specialized computer, in a small, affordable package.

We're talking about *IPStar* ($249) from DSG, Inc. Plug any phone into it, plug the IPStar into any phone line, and you're ready to go. The IPStar handles the Internet connection with its built-in 56-Kbps modem (you, of course, have to have a Net account). Once you set up the device to work with your Internet dial-up account—a one-time process where it stores your local access number, username, and password—the IPStar can go online. Then, making a call is as simple as dialing a number on your standard phone.

Now, if your recipient has an IPStar (or a PC-based VoIP system), all your calls will be free, making this the perfect investment for two or more people who really plan on spending a lot of time speaking long distance. If the person you're calling does not have any VoIP solution setup at all, you can still call

Net2Phone's software of the same name uses a familiar interface to let users call over the Net with their existing computer hardware. Still, additional hardware, like the products explored in the article, are recommended for increased quality.

VENDOR INFORMATION

***Action*tec Electronics, Inc.**
760 North Mary Avenue
Sunnyvale, CA 94086
408-752-7700
www.actiontec.com
CIRCLE 180 ON FREE INFORMATION CARD

DSG, Inc.
17800 Castleton Street
Suite 230
City of Industry, CA 91748
626-912-0388
www.ipstar-dsg.com
CIRCLE 181 ON FREE INFORMATION CARD

Net2Phone
171 Main Street
2nd Floor
Hackensack, NJ 07601
800-438-8879
www.net2phone.com
CIRCLE 182 ON FREE INFORMATION CARD

Quicknet Technologies, Inc.
520 Townsend Street
Suite D
San Francisco, CA 94103
415-864-5225
www.quicknet.net
CIRCLE 183 ON FREE INFORMATION CARD

him or her, again using a gateway.

Gear-Free Cheap Calls. Here it is, that wonderful service we've been commenting on, that one that's saved us hundreds of dollars since we signed on over two years ago, that one that's acting as gateway provider for several vendors' products. Further, Net2Phone is the first and best way to leave the hardware woes to others, and call over the Net from any phone to any phone.

Think of Net2Phone as a company that carries your IP voice data for you, and lets you choose how to send and where to send this data.

First, you can use Net2Phone's software of the same name to talk over the Net, though you'll be victim of some of the problems we cited at the beginning of this article. The situation is made worse if you try using such software with a half-duplex sound card, which forces you into a CB-like communication system where you can listen and then talk only after pressing a button that appears onscreen.

A better way to use the *Net2Phone* application is in conjunction with one of the aforementioned PC-connected devices. This proves the company knows how to get good sounding calls over the Internet, with the right hardware.

And they do have some great hardware at the various Net2Phone gateway centers around the country. Thanks to these nodes, you can access Net telephony from payphones, hotel rooms, anywhere, without cranking up the PC. All you need is a *Net2Phone Direct* calling card. Use it to call anyone in the U.S. for about five cents a minute, providing you can make a local call. Those who need to access Net2Phone's toll-free number will pay more (though not as much as traditional calling cards).

Some of you may be wondering why you should ever bother with a hardware solution when calling someone through a gateway provider. Why not use your Net2Phone card from home?

While the company would like you to do just that, we should point out that when you're home, it's almost always best to use a hardware solution like the one's we've been exploring. Even if you'll have to be charged a per-minute fee to call someone who doesn't have the right gear, your call quality will be best when your PC or standalone device is working on your call to make it sound great. As good as Net2Phone may be, sometimes heavy call volume at its centers does affect sound quality. Your own gear could take the edge off that.

Further, you'll save money (another 1.1 cents) in the long run using hardware. Remember, Net2Phone charges only 3.9 cents a minute when you provide a software or hardware front end.

So enjoy Internet calling—take advantage of the money-saving aspects of it.

Until the Phone Company finds a way to cash in on the action, that is. Ω

SYSTEM DESIGN

(continued from page 42)

that the Presario 5868 sports. As a higher-end system, it has all the bells and whistles you might expect, starting with 128MB of RAM and a fast 7200-rpm 20GB hard disk. The disk controller (and hard disk) are Ultra ATA/66 models, which offer twice the burst data-transfer rate of the previous Ultra ATA/33 controllers and drives.

The Presario 5868 is also definitely ready for anything. Along with built-in adapters for 10BASE-T Ethernet networking and a home phoneline network adapter, there's also a dual modem which functions as a 56K analog modem or, if DSL service is available in your area, a 6-Mbps G.Lite DSL modem.

Previous Presario models have offered a 100MB Iomega Zip drive for backup and file transfer. The Presario 5868 also offers this option if you want it. However, our review unit offered an even better goodie—a 4X2X24X CD-RW drive. The designation details the 4X speed it will burn a CD-R disc, the 2X speed it writes to CD-RW, and the 24X speed that standard CD-ROMs are read in the drive. Along with a comprehensive bundle of software that includes Microsoft *Office 2000*, a copy of CeQuadrant's *just!burn* software is provided so that you can get the most use out of the CD-RW drive. P

SPECIFICATIONS

Model: Compaq Presario 5868
Price (as configured): $2598
Vendor: Compaq Computer Corp., 20555 State Highway 249, Houston, TX 77070; 800-345-1518; *www.compaq.com*
CPU: 600-MHz AMD Athlon
Memory: 128MB SDRAM, expandable to 384MB
Storage: 20GB Ultra ATA/66 hard disk, 1.44MB floppy disk
ROM Drives: 8X DVD, 4X2X24X CD-RW
Video: 19-Inch Compaq MV920 monitor, 3dfx Voodoo 1000 with 16MB RAM
Audio: SoundBlaster PCI128 wavetable, JBL Pro stereo speakers included with monitor
Size: 20.9 × 8.38 × 19 inches (HWD)
Ports: Parallel, serial, VGA, two USB, two IEEE-1394
Expansion: Two PCI slots, one external 5.25-inch bay, one external 3.5-inch bay
Other: Windows 98, complete software bundle, 10BASE-T adapter, home phoneline network adapter, G.Lite DSL modem
CIRCLE 120 ON FREE INFORMATION CARD

Apple's Wireless Breakthrough

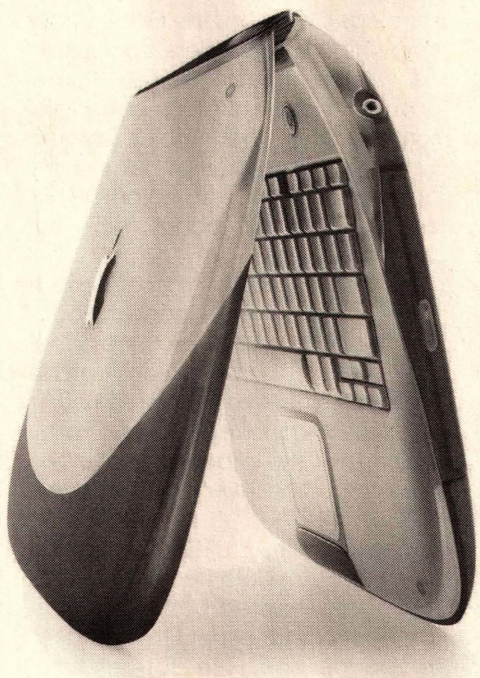
Yes it's colorful, yes it's affordable ... but it's also the herald of a new era in tether-free computing.

KONSTANTINOS KARAGIANNIS

Apple is a company that takes its "Think Different" slogan very seriously. Its iMac did so well that it not only broke sales records, but also gave a boost to the at-the-time-wobbly USB market. Since the only interface the first iMac had was USB, owners of the colorful computer had to run out and buy USB peripherals, which manufacturers were happy to supply. Thinking different launched a new era in computer I/O, even though USB was originally devised for the Windows world.

The iMac is now available in a version for those on the go, and this device too comes with its own "different" bit of I/O technology. Perhaps you've heard of the *iBook*, that tangerine- or blueberry-colored laptop that was on every student's Christmas list. At $1599 it was priced to move (at least for a portable computer), and it came with a lot of the right "notebook stuff" for the list price.

However, while some critics griped that it was too cute to be a serious machine (okay, maybe a graphite-colored model would have been a good idea), and that all Apple products are overpriced for what you get (here we disagree—iBook and iMac are definitely not expensive for their particular class), most reviewers missed the point:



The iBook is in many ways the most innovative laptop on the market (and this from a magazine that uses PCs ... go figure). But don't take our word for it, like those other reviewers wanted you to. Let the facts speak for themselves, starting from the machine's construction and moving on to its wireless breakthrough.

Durable in Many Ways. People purchase notebooks with the thought of using them for several years to come. Unfortunately, a great many don't make it past a couple of strenuous years spent on the move. Whether they meet their demise in the hallway between classes, or tumbling down the escalator at an airport, laptops often perish due to a combination of poor handling and poorer still design.

While companies can't do anything to control how you treat your notebook, they can make sure it's tough to start with. That's what Apple did with iBook.

As a great many students are likely to be toting these colorful gems around (and plenty of business people, too, especially if the company would release one in a "softer" color), iBook is encased in a plastic body with a special shock-absorbing, flexible region. The latter is designed to protect the bright 12.1-inch active-matrix screen and internal electronics. Should the machine take a hit now and then, we think it will be able to stand it.

To reduce the chance of the notebook slipping out of your arms, there's a foldaway handle (behind the screen hinge) that makes it easier to carry the machine around. The part of the iBook that will then touch down on, say, a table, is some of the thickest plastic on the body. Incidentally, that part of the unit—where the screen lid opens—has no latch that can break and fall off. You instead gently pull the lid open to free it from the spring-like pressure that keeps it closed.

Our only complaint with the

iBook's outside design is that maybe it's a bit too big for the size of screen it houses. As we learned, though, Apple did have to cram something else in the screen bezel, but we'll get to that in a bit.

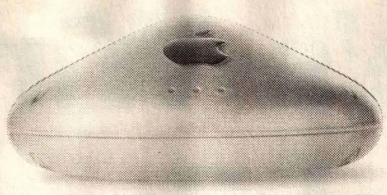
Inside the bottom half, the machine features an equally durable feature found on almost no other portable: A long, long lasting Li-Ion battery. While most other laptops run out of juice after an unplugged two hours or so, the iBook keeps going for up to six hours! This represents average use, of course, but even if you keep the 24X CD-ROM drive spinning and some CPU-intensive software running, you should more than double the battery-charge life expectancy of those "other" notebooks.

At the heart of the iBook is a 300-MHz PowerPC G3 processor. This might not seem very fast in this day of 450-MHz notebooks, but the G3 does hold up well when compared to Pentium II architecture of higher clock speeds. This is thanks to the G3's high-speed 512K backside L2 cache. And while newer PIII notebooks should seem significantly faster than all but the fastest G4 (not a mobile chip yet), you won't be able to find a PIII notebook (or many PII's for that matter) for anywhere near iBook's price.

When it comes to computing "guts," our only complaints are that maybe iBook should come with 64MB of RAM standard, instead of 32MB, and that perhaps the 3.2GB drive could have been a bit more capacious. But again, considering the Apple portable's low price, we can't exactly call these two comments "gripes."

Like the iMac, the iBook has no floppy drive. Apple feels most file transfers are done either over networks or via external storage devices, and the engineers there are probably right. How many files does a modern, multimedia computer generate that will fit on a floppy? Except for basic text stuff, just about everything else requires something like a Zip drive, which you can easily add to your iBook via USB.

To take advantage of aforementioned networking and the Internet, iBook comes with a built-in 10/100Base-T Ethernet adapter (a rarity in this price range) and 56-Kbps modem. However, when you're at home, the office, or a properly equipped classroom, you might not need to use either wired connection.



No it's not a UFO, but Apple's AirPort Base Station does offer futuristic possibilities. With it, your iBook can surf the Net wirelessly from up to 150 feet away.

Going Wireless. As attractive and sturdy as it may be, the iBook's true innovation is its wireless capability. As we mentioned earlier, Apple had to allow room for a certain something in the iBook's screen bezel. That something? Why, twin antennas. They run along the edges of the LCD panel inside the rim plastic.

To make use of those covert strips of metal, you'll need to add two things to your iBook. One is the $99 *AirPort Card*, which installs underneath the keyboard (an easy upgrade that takes less time than waiting for the machine to boot). The other is the *AirPort Base Station* ($299).

Looking like a UFO from a 50's sci-fi flick, the AirPort Base Station is a graphite-colored dome that has connections for either Ethernet or a telephone line. The former can accept a 10/100Base-T line or a cable modem, the latter is actually a 56-Kbps modem. Once the Station is connected to either an Ethernet or phone line, you can enjoy wireless Net surfing at distances of up to 150 feet.

And unless you're at the edge of the 150-foot radius, your connection will not be hampered by its wireless nature. The AirPort system can support up to 11 Mbps, which is one megabit per second faster than the fastest home broadband connection. True, corporate networks are faster, but individual users can rarely access more than 10 Mbps anyway, due to individual bandwidth restrictions.

The AirPort Base Station also allows users to share Internet connections, as well as exchange files and access a printer. Even the new iMacs can accept AirPort Cards, meaning you can have a whole family of computer users accessing the Net, all without adding extra phone lines or cables.

Is there anything we don't like about the AirPort system? Yes. Why didn't they release it sooner?

The System's New System. The Gates world of computing does offer more software and peripherals to choose from than the "different" one (check out the Mac section of a computer store and you'll find it's about a tenth the size of the PC/Windows section—*i.e.*, the rest of the store). But the Mac OS is not too shabby—it's just the underdog in a long battle.

To prove Apple is a contender in the operating-system arena, it sent us the new Mac OS 9 to install in our iBook. The ninth full version of the OS features, appropriately enough, nine Internet tools, including Sherlock 2 (similar to Microsoft's Channels), an encryption tool for secure transfers of data, and even an applet (Keychain) that lets different users store user names and passwords for Web sites. A non-Web feature we really loved, though, is the Voiceprint Password, which lets you secure access to your computer with the sound of your voice announcing a password of your choice. Very high-tech for an OS-bundled feature.

However, we did have a complaint with the new OS, too. While the installation process was simple, it did create a few post-install problems. Notably, several Mac extensions were, well, to put it bluntly: messed up. This could be frustrating for those new to Macs, so you might

(continued on page 50)

VENDOR INFORMATION

Apple Computer, Inc.
1 Infinite Loop
Cupertino, CA 95014
800-795-1000
www.apple.com

CIRCLE 190 ON FREE INFORMATION CARD

SELINA KYLE

An Affordable Backup Solution

If you use your PC even once a week, there's a good chance you've got some critical data on its hard drive. It's inevitable: Type on a keyboard long enough, and you're bound to enter something that's worth saving.

Of course, that is an oversimplification. Those of you running your own business amass a great many records you couldn't do without. And, for a less critical situation, what about those of you who just have their machines set up perfectly and don't feel like having to individually reload a ton of software and drivers?

Disaster can strike. Your machine's hard drive can die. What would you do in such a dire hour were it not for your backup?

What's that? You don't have a backup solution? No expensive tape drive sits in one of your PC's drive bays?

Well, then, have we got the perfect backup system for you, fellow do-it-yourselfer. With it, you can have all the benefits of a tape backup, without feeling like you just invested in another computer.

Backer 32 is a ready-to-use solution. Just add a VCR and high-quality tapes to easily store gigabytes of data. Shown here is the external version, which requires a PC with an ECP parallel port.

YOU'VE GOT A VCR, RIGHT?

Introducing Danmere's *Backer 32*, a high-performance device that takes advantage of a piece of technology found in most any home. Available as an internal ISA card ($69) or external ECP parallel-port device ($89), the Backer connects to a standard VHS VCR and converts computer binary data (zeroes and ones) into a format that can be stored on VHS tape. Best of all, you don't need to devote a VCR to Backer's use—only connect it for data archiving or restoration. Those of you with a computer and TV in the same room will have little trouble with such an approach.

Viscount Video Sales, a US distributor selling Backer 32 (Danmere is a UK company, so we included a US sales contact for our readers) even offers a wireless add-on, called the *CT-100*, which will let your computer control the VCR's record and playback functions. Even without this $49 extra, the Backer is easy to use and, fortunately, easy to install.

VENDOR INFORMATION

Viscount Video Sales
8405 Pheasant Drive
Florence, KY 41042
877-847-2686
www.backer32.com

CIRCLE 110 ON FREE INFORMATION CARD

MINUTES, JUST MINUTES

In a moment we'll be discussing the number of megabytes you can store on each minute of tape, but for now, we have to point out how few of your precious minutes will be spent setting up the Backer 32. We received the external unit for review and were able to get it running in very few of those 60-second periods.

Installation consists of first loading the software that comes on a floppy disk with the unit. As program code is always updated in this fast-moving computer biz, be sure to check the Backer 32 Web site for a more current

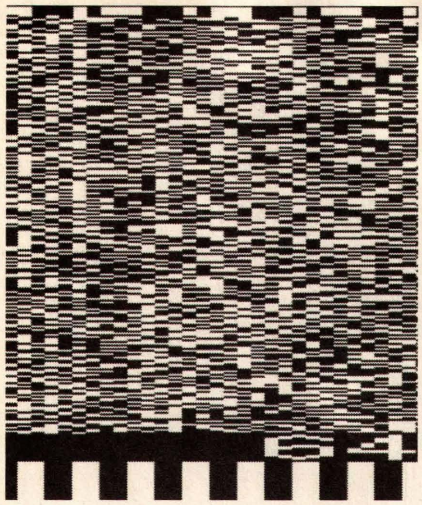


Fig. 1. Playing a Backer 32 tape in a VCR will help you find a particular file. The number shown at the screen bottom will correspond with a file in your template or "save log."

version (click on the link that offers a "more comprehensive technical specification" to find the program update). Use the PARACHK utility (on the floppy) to make certain your port is set for ECP mode. If it isn't, you'll need to follow the steps included in the concise Backer 32 manual to set the port to ECP in the BIOS setup and Windows Device Manager.

After the software's installed, shut down your machine and connect the external version of the Backer 32 to your machine's parallel port using the included cable. Don't worry—the Backer 32 has an auxiliary or pass-through connector for your printer, should your machine not have two parallel ports. If you bought the internal version, insert it into an open ISA slot at this time.

Connecting the VCR is a cinch. Data is sent between it and the Backer 32 via a standard composite-video cable (with RCA plugs) that's included. Just attach the VCR's "video out" and "video in" jacks to the Backer 32's "in" and "out" connectors, respectively. Attach the AC adapter to the Backer 32, and you're set. Boot your system to get started.

MAKING TAPES

You have two main ways in which to use the Backer 32: Option one is to choose certain data that you want backed up or archived and copy it to the VCR using the *Backer* software. Your other option is the innovative one that might really save you from disaster....

The *Backer* application lets you create a template of files you want it to regularly archive. While your operating system's basic settings need only be backed up every few months, certain files and folders you're constantly modifying or adding to should be archived more often. Use *Backer* to choose which data you can't live without, and you'll then be certain to never face such a bleak possibility.

How much can you fit on one tape? The answer to this question depends on a choice you'll have to make. In the system's Mode 1, Backer 32 will store up to 9MB per minute. That translates to approximately 1, 2, or 3GB capacities in 2-, 4-, or 6-hour VCR record settings (note that most modern VCRs only let you choose between SP or EP for 2 or 6 hours, respectively).

Mode 2 stores a less cluttered amount of data per minute of tape. The capacity is limited to 4MB per minute, which translates to 500MB, 1GB, or 1.5GB of data on the three VCR speed settings.

Now, did you ever notice how poor image quality is when you set your VCR to EP mode? Imagine what could happen to data stored on such a "rushed" medium setting. We feel your safest bet is to store data only in Mode 2 (4MB per minute) and at a slow tape speed (SP). While this will limit you to 500MB a tape, you won't have to worry about data corruption. This will likely be your only backup, after all, and you want it to be a good one.

Also, for best results, use a high-quality tape. Avoid those "no-name" 50-cent tapes that you find in five and dime shops.

GETTING IT BACK

We were very impressed with the way in which you can recover particular files from a VHS tape. Surprisingly, if you play back the tape in the VCR (connected to a TV) you will see more than static. At the bottom of the screen will be bars and a number (see Fig. 1).

The changing numbers onscreen will correspond to the files in your template or "save log." If file 64, for instance, is the one you want, then look for it using Play and Fast Forward combined and stop the tape when you get to it. Then connect the VCR to Backer 32 to copy the file you want to the PC.

Overall, Backer 32 is a great product. Even users with a minimal PC (386 CPU, 4MB of RAM, 3.5-inch floppy disk drive for installation, and Windows 3.1/95/98) can use it to avoid losing those precious keystrokes and downloads.

I guess that about does it for this month. If you'd like to get in touch before next column, contact me care of *Peak Computing*, **Poptronics**, 500 Bi-County Blvd., Farmingdale, NY 11735, or directly via e-mail at *selinakyle@techie.com.* P

APPLE'S BREAKTHROUGH

(continued from page 48)

want to check Apple's Web site to see when a simple fix for this problem will be available (if not already available by the time you read this).

Or, better yet, the iBook you buy might come with OS 9 installed and configured. When it's set up properly, it really is a noticeably better operating system than its Mac OS predecessors.

The Pluses Add Up. For the money, the iBook is a great mobile computer choice, if you can manage to work outside the Windows world. Feel like thinking different? It's scary, we know. But we have to admit that for a great many types of users, going the mobile Apple way is not a bad move, even if you have a PC for a desktop. Depending on the applications you use, you may be able to share data between the worlds, so to speak.

Just one more thing. Actually, this last comment is to the folks at Apple, but you can read on, too.

See the color of the AirPort Base Station? Think that color for the next release of iBook. Some of us adults want to carry them around in public, too. Ω

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TED NEEDLEMAN

COMPUTER BITS

Home Phoneline Networking

While just a decade ago it was a rarity for a household to have any PCs, today it's common for many homes to have more than one. And, where there are multiple PCs, there's a good chance that a network would make all of the PCs in the home more useable.

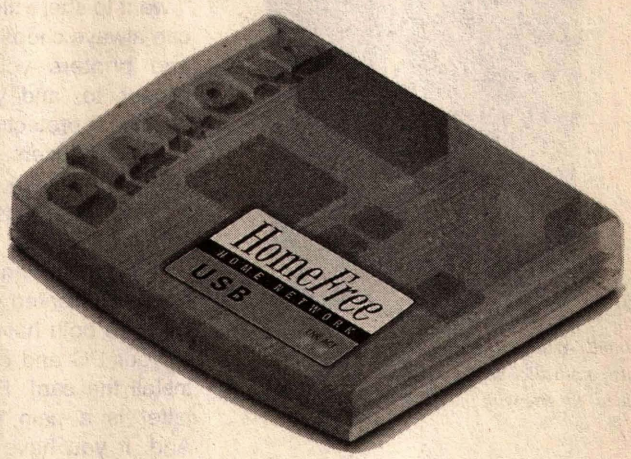
Forget about "sneakernets." Why run around the house carrying floppies with files on them? Also, as many home-networking vendors are pointing out, a network lets you share peripherals, such as a printer or a Zip drive. You can also share an Internet connection—a particularly attractive idea if you have a high-speed service such as cable or ADSL.

These aren't the only reasons to install a home network, however. In our house, we frequently have multiplayer "gamefests" (though only when all the schoolwork is done). Currently, the big game everyone likes to play in multiuser mode is *Tom Clancy's Rainbow Six Rogue Spear*. I'm not sure whether the four kids are collaborating on their assaults or trying to finish each other off. And I'm afraid to ask. As long as they confine their aggression to make believe, I don't really have a problem. A good part of my nonchalance, however, comes from the fact that the kids are likely to collaborate on schoolwork, share files and ideas, and even proofread and correct each others' documents over the network.

Any way you look at it, home networking is a wonderful way to maximize the potential of the computers you own. Interested? Great. Let's look at your options.

OUT WITH THE OLD

For best at-home results, we've tried a variety of different networking approaches, all based on the Windows peer-to-peer model, where none of the PCs acts as a dedicated server. Since the PCs are located across three floors of our home, and I'm pretty klutzy when it comes to dragging wires through the wall, 100Base-T Ethernet has been ruled out until I can find the money to have unshielded twisted pair wiring pulled all through the house. It's a shame, too, as I've come across some uncomplicated 10 and 100Base-T Ethernet networks, and they're really easy to get up and running, especially under Windows 98, if you can run the wiring.



Diamond Multimedia's HomeFree phoneline adapters, available in USB (shown here) and internal versions, let you use existing phone lines to network PCs at speeds of up to 1 Mbps.

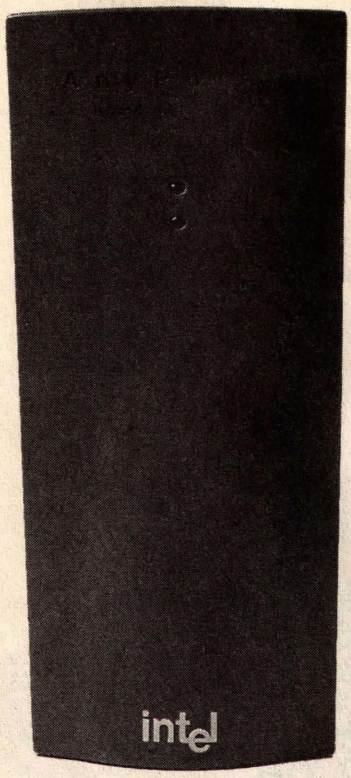
Or you can do away with wires all together.

When the first inexpensive RF networks became available a year ago, we installed Diamond Multimedia's *HomeFree* network on about four of our PCs (remember, we're reviewers here—machines add up). Unfortunately, we experienced severe distance restrictions with the radio-based network. While a range of up to 150 feet was claimed, we usually couldn't get the systems downstairs to talk with the ones upstairs. And while we live in a nice-sized home, it's just not that large that we expected the distances to actually matter.

USE EXISTING WIRING

Our latest adventure in networking has proved a bit more successful. About a year-and-a-half ago, an industry consortium was formed to define the specifications on how to use the wiring already inside your home to provide the capability of connecting PCs together. The first attempt at this—power-line networking, or the superimposing data over the power line frequency—hasn't worked well. That's why the new organization, called the Home Phoneline Networking Alliance, or HomePNA, felt that wiring already designed to handle data—telephone wiring—may provide a better means of networking.

The specifications HomePNA came up with overlay network data into the frequency range of 5.5 to 9.5 MHz. That's well above the zero to 4-KHz range used for telephone calls, and the range of 25 KHz to 1.1 MHz used by most home ADSL systems. Using the allocated frequency, the specification calls for a transmission speed of 1 Mbps, or about a tenth of the speed of standard 10Base-T Ethernet, and a



Intel's AnyPoint external phoneline adapters use a parallel-port connection, making them ideal for use with pre-USB PCs.

hundredth of the speed of 100Base-T Ethernet.

That sounds awfully slow, but it's not really, at least in most applications that you'd run in your home. Further, the home phoneline networks are really easy to set up. We found this out firsthand when experimenting with three different types of phoneline adapters—two from Diamond Multimedia, and the third from Intel. They all "talk" very nicely with each other.

SETTING UP, INTERNALLY

The first type of cards we installed were *HomeFree Phoneline Network* cards from Diamond. These are internal cards that are placed in an empty PCI slot in your PC. You then attach a standard phone cable from the card to a telephone jack. As with a modem, you can also plug your phone into the card and make ordinary calls. Or, the way we did it in most of the rooms of our house, you can use a multiple tap converter on the telephone jack, which gives you two or three jacks for telephone cables.

Once the cards are installed, run the installation software. In about 20 minutes, you can have two, three, or more network stations talking and transferring files with each other.

The standard method for transferring files that's used by all of the phoneline networking offerings that we've seen is to build a "transfer" folder, where you can place files you want other network users to access. But the more standard approach of mapping drives and printers works just as well, if not better. This involves going into the Windows Control Panel, clicking on the Network icon, and enabling sharing by checking the line that reads "I want to share files and printers." You can always choose which drives, files, and printers you want to provide access to, and you can also place password protection to limit access to authorized users. The latter's great if you have private data on your PC or want to keep kids away from certain items.

While the internal cards from Diamond worked well, they do require that you both have an empty PCI slot in your PC and open up the case to install the card. For many users, the latter is a pain they'd rather avoid. And, if you have purchased a really inexpensive PC, you may not have, or want to use, the limited slots available. Fortunately, there's an external solution that works real well.

GOING EXTERNAL

Intel's *AnyPoint* is a terrific external phoneline adapter with a sleek look. It's a couple of inches wide and about seven inches tall, and it comes with a small AC power supply. The external AnyPoint adapters have two features I like a lot. The first is that the adapter simply plugs into the parallel port of your PC, so, as mentioned, there's no need to open the case.

The second feature is that the installation software lets you install just the networking software, and not the Internet-sharing software. That's a big plus when you are running a network with adapters from different vendors. Very often, different vendors use different software utilities to provide the Internet-sharing capability. And since different vendors all support the HomePNA standards, different adapters can "talk" to one another. But we've had our home network crash a number of times until we figured out that the Internet-sharing software from different vendors was not really compatible. So being able to not install it lets our Intel AnyPoint adapters work fine with, say, the Diamond HomeFree adapters.

Speaking of Diamond, the company also recently introduced an external version of its HomeFree adapter. This newer model is USB-interfaced, so it simply plugs into a USB port on your PC. We set ours up in under five minutes.

FINAL CONSIDERATIONS

The Home Phoneline Networking Alliance has also set the standards for a 10-Mbps phoneline network, and equipment meeting this standard should start appearing soon. That will provide even better performance for those who need it, though the six PCs on our home network have not provided any complaints as of yet.

As with any computer technology, you'll have to decide if you want to wait for the next great thing, or if you need to buy into what's available now.

And if you are buying today, keep in mind that phoneline network adapters tend to be a bit more expensive than standard Ethernet adapters. The internal Diamond cards cost about $50 each, and the external USB model is just under $70. Intel's AnyPoint runs about $160 for two adapters.

On the other hand, phoneline networking doesn't require an Ethernet hub or switch, so you save money on that. Best of all, it really is one of the easiest ways to connect all your PCs.

As always, if you have any questions or comments about *Computer Bits*, feel free to send me an e-mail at *tneedleman@aol.com*. P

VENDOR INFORMATION

Diamond Multimedia Systems, Inc.
312 SE Stonemill Dr.
Suite 150
Vancouver, WA 98684
541-967-2450
www.diamondmm.com
CIRCLE 100 ON FREE INFORMATION CARD

Intel Corporation
2200 Mission College Blvd.
Santa Clara, CA 95052
408-765-8080
www.intel.com
CIRCLE 101 ON FREE INFORMATION CARD

KONSTANTINOS KARAGIANNIS

NET WATCH

Find Anyone, Anywhere

As big as this planet may be, we're always hearing about how the Internet is making it smaller. Yeah, it's a modernized cliché, but it still is true. Visit a search engine and type in the name of a friend—even one you haven't seen in years—and you may just end up at his or her Web site. Unless the buddy's name is John Smith, that is.

However, regardless of how common or unusual your long-lost loved one's name may be, he or she may not have a Web site. Can you still use the Net to track this person down? You bet you can.

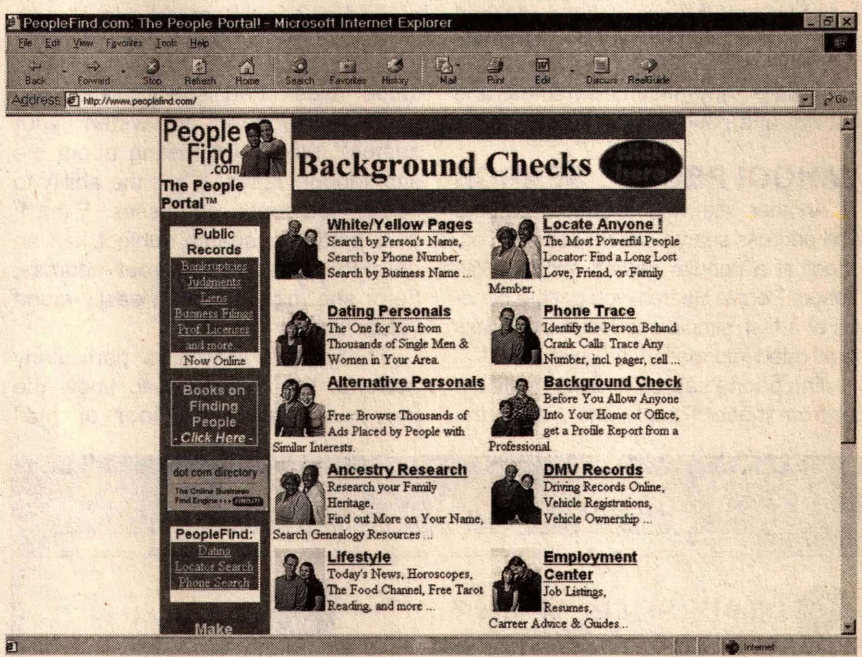
Before you go hiring expensive private eyes to find your siblings, pals, or perhaps characters who owe you money, try out the sites we cover this month. About half the tools we present here are free, with the other "extra services" costing a modest amount. Either type may just do the trick.

PEOPLEFIND

I guess the name says it all. Chances are PeopleFind can handle any search for you, from the simplest free phone number queries to advanced inquiries into driver's license and other records. As you might have guessed, the latter services do cost, but cost much less than hiring someone.

When you first log on to it, PeopleFind presents you with quite a few links to choose from. For most cases, you should be able to get by with the White/Yellow Pages. Clicking on this will bring up two powerful query tools.

The first tool lets you enter a person's first and last name, the state they live in (required), and the town if you know it. Be as specific as you can at first, but realize that people do change names, especially women who get married. Also, people move. You may have to remove specifics such as town and last name and hope for the best in some instances. If you succeed, you'll get an address or at least confirmation of the person's town, and a—please applaud—phone number (provided that the latter's not unlisted).


PeopleFind.com: The People Portal! - Microsoft Internet Explorer
Address http://www.peoplefind.com/
PeopleFind.com
The People Portal™
Background Checks
Public Records
Bankruptcies
Judgments
Liens
Business Filings
Prof. Licenses
and more
Now Online
Books on Finding People
- Click Here -
dot com directory
PeopleFind:
Dating
Locator Search
Phone Search
Make
White/Yellow Pages
Search by Person's Name, Search by Phone Number, Search by Business Name ...
Locate Anyone !
The Most Powerful People Locator: Find a Long Lost Love, Friend, or Family Member.
Dating Personals
The One for You from Thousands of Single Men & Women in Your Area.
Phone Trace
Identify the Person Behind Crank Calls Trace Any Number, incl. pager, cell ...
Alternative Personals
Free: Browse Thousands of Ads Placed by People with Similar Interests.
Background Check
Before You Allow Anyone Into Your Home or Office, get a Profile Report from a Professional
Ancestry Research
Research your Family Heritage, Find out More on Your Name, Search Genealogy Resources ...
DMV Records
Driving Records Online, Vehicle Registrations, Vehicle Ownership ...
Lifestyle
Today's News, Horoscopes, The Food Channel, Free Tarot Reading, and more ...
Employment Center
Job Listings, Resumes, Carreer Advice & Guides...

The name says it all. With PeopleFind free tools and pay services, you're certain to get in touch with ... well, anyone.

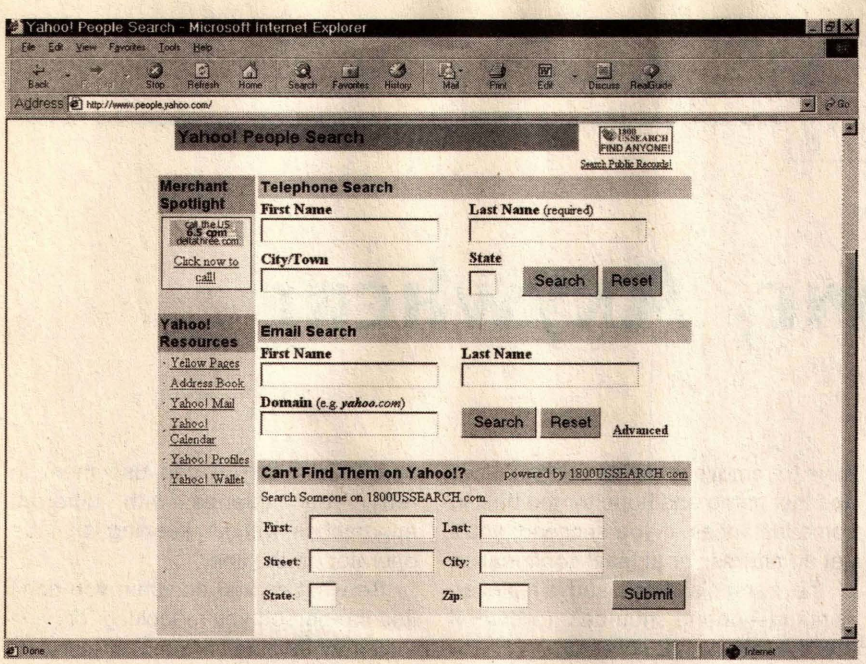
The second phone tool is the much-coveted reverse directory. Remember when these were published as books that you just couldn't get your hands on? With this online version, you can enter a phone number and find out just whom it belongs to. This is particularly handy if you don't want a certain someone to know that you're trying to verify they are where you thought they were.

Of course, the preceding tools are not much better than telephone information (even though the latter can cost as much as a buck). Their biggest benefit is that you can use them to retry your queries with different approaches without keeping an irate operator on the line.

So what do you do when you don't find the person you're looking for?

It may be time to fork over just a little money. Head back to the main page of PeopleFind and you'll find a link called Find Anyone! whose exclamation point is certainly justified. Click on the link and gain access to true snoop power.

For $39.95, PeopleFind guarantees it will find your certain someone. All you need to know is their first and last name, and one of the following: a possible state of residence, a previous address, or a date of birth. Then, within one business day, you'll receive info on the person's current and past



Search for more than cool Web sites at Yahoo!—the site's People Search provides quick access to listed numbers, addresses, and even e-mail addresses.

addresses, any assumed names, and current and past phone numbers.

YAHOO! PEOPLE SEARCH

Another site with telephone-number and address search capabilities is an offshoot of a popular search engine. With Yahoo! People Search, you get the benefits of a fast, simple interface and access to all listed information nationwide.

The phone search doesn't really differ from that of PeopleFind. Follow the same rules (start specific and lose some information to widen your search). What's interesting about the site, though, is that it has the ability to search for e-mail addresses. Even if your particular search subject has an unlisted number and street address, he or she might have an easily found virtual "addy."

The e-mail search is particularly powerful if you happen to know the person's Internet provider or mail domain (*i.e.*, the stuff after the "@"—*gernsback.com*, for example). You might have this info if the person e-mailed you a while ago, and you just can't remember what his or her username at, say, AOL was.

You'll note that regardless of which type of search you initiate, your results will be accompanied by links after each entry. Depending on promotions and such, these links could ask if you want to send flowers or a greeting card to said individual. As we've said in the past, advertising is popping up in the weirdest places on the Net. Just be happy you've found your friend—only send flowers if it's sure to help your chances at bringing this person back into your life!

1-800-U.S. SEARCH

Another link you might have noticed on the Yahoo! People Search site is one to 1-800-U.S. SEARCH, the premiere person-finding service that has been featured on more talk shows than you might have thought were even on the air. While their service is the most expensive at $49.95 and up,

HOT SITES

1-800-U.S. SEARCH
www.1800ussearch.com

PeopleFind
www.peoplefind.com

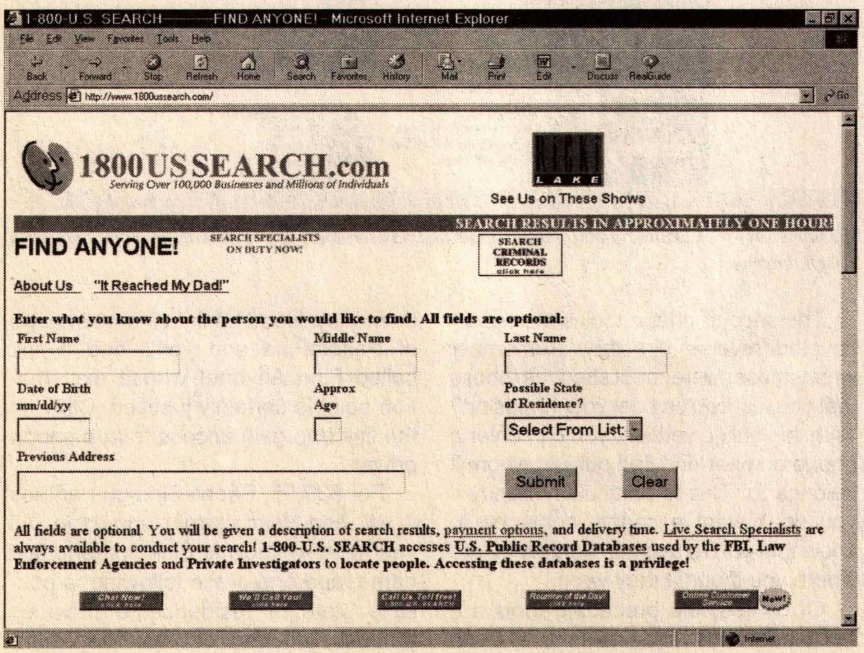
Yahoo! People Search
www.people.yahoo.com

the staff at 1-800-U.S. SEARCH may be able to find your guy or gal within—get this—an hour!

Check out their site and you'll find that you can discover a lot more than just addresses and phone numbers. Gain access to death records, court documents (any liens against this person?), and other materials.

The search specialists you'll get in touch with can even help you find a lost adopted sibling or child, still for much less than a local PI would be able to charge. If the free alternatives aren't cutting it, and you really have to find someone, you should give serious thought to this powerful online service.

Lots of luck with your searches. Oh, and if you need to find me, I'll make it easy for you. I can be reached via snail-mail at *Net Watch*, **Poptronics**, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mail at *netwatch@gernsback.com*. P


1-800-U.S. SEARCH——FIND ANYONE! - Microsoft Internet Explorer
1800USSEARCH.com
Serving Over 100,000 Businesses and Millions of Individuals
See Us on These Shows
SEARCH RESULTS IN APPROXIMATELY ONE HOUR!
FIND ANYONE!
SEARCH SPECIALISTS ON DUTY NOW!
SEARCH CRIMINAL RECORDS
About Us
"It Reached My Dad!"
Enter what you know about the person you would like to find. All fields are optional:
First Name
Middle Name
Last Name
Date of Birth mm/dd/yy
Approx Age
Possible State of Residence?
Select From List:
Previous Address
Submit
Clear
All fields are optional. You will be given a description of search results, payment options, and delivery time. Live Search Specialists are always available to conduct your search! 1-800-U.S. SEARCH accesses U.S. Public Record Databases used by the FBI, Law Enforcement Agencies and Private Investigators to locate people. Accessing these databases is a privilege!

Either type in their URL or dial their name on a phone, and the staff of 1-800-U.S. SEARCH may be able to find anyone within an hour!

GORDON McCOMB

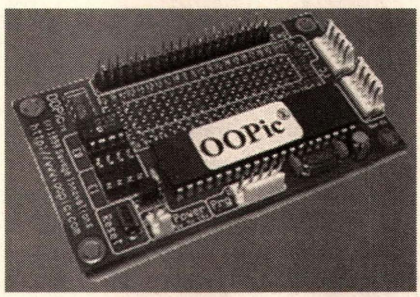
Watch Out BASIC Stamp... Here Comes the OOPic

The art and science of robotics changed dramatically with the advent of the BASIC Stamp, first introduced in 1994 by Parallax, Inc.—at the time, a relatively unknown electronics firm located in the foothills of California's Gold Rush country.

Since its inception, the BASIC Stamp has provided the "on-board brains" for countless robotics projects. That thumb-print sized microcontroller uses BASIC-language commands for instructions, and is popular among robot enthusiasts, electronics- and computer-science instructors, and even design engineers looking for an inexpensive alternative to microprocessor-based systems. The original BASIC Stamp 1 has been greatly enhanced; new models sport faster speeds, more memory capacity, easier software programming, and additional data lines for interfacing with motors, switches, and other robot parts.

The BASIC Stamp is really an off-the-shelf PIC (programmable integrated circuit), encoded with a proprietary BASIC-like language interpreter, called PBASIC. The chip stores commands downloaded from a PC or other development environment. When the program is run, the language interpreter built into the Stamp converts the BASIC syntax into instructions the chip can use. Common instructions involve such things as assigning a given data line as an input or output, or toggling an output line from high to low, in typical computer-control fashion.

The net result is that the BASIC Stamp acts like a programmable electronic circuit, with the added benefit of intelligent control—*minus* the complexity and circuitry overhead of a dedicated microprocessor. Instead of building a logic circuit out of numerous inverters,



The OOPic supports 31 I/O lines, and runs on 6-12-volt DC power. Connectors are provided for the I/O lines, programming cable, memory sockets, and Philips I²C network.

AND gates, flip-flops, and other hardware, you can use just the BASIC-Stamp module to provide the same functionality, doing everything in software. (To be truthful, the Stamp often requires at least some minimum external components to interface with real-world devices.) Nor do you need to construct a microprocessor-based board for your robot, followed by programming the thing in some arcane language.

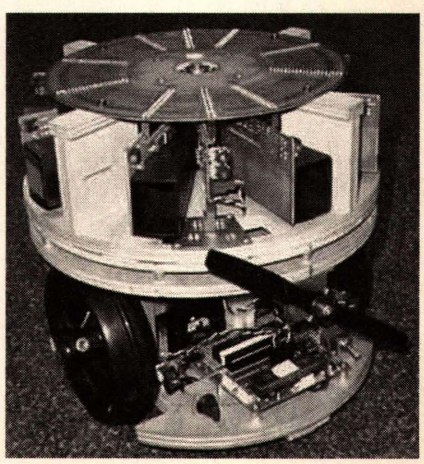
Because the Stamp accepts input from the outside world, you can write programs that interact with that input. For instance, it's a slam dunk to activate an output line—say, one connected to a motor—when some other input (like a switch) changes logic states. You could use that scheme, for instance, to program your robot to reverse its motors if a bumper switch is activated. Since that's done under program control, and not via hard-wired circuitry, it's easier to change and enhance your robot as you experiment with it.

First the Basic Stamp...Now the OOPic

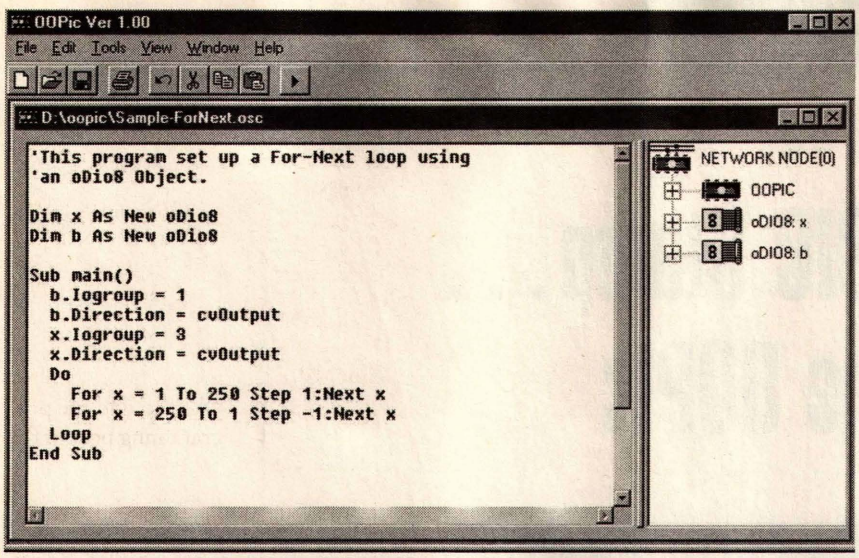
While the BASIC Stamp is a favorite among robot enthusiasts, it is not the only game in town. Hardware designers who know how to program their own PICs can create customized microcontroller circuits, using state-of-the-art devices, such as the PIC18CXXX family of 8-bit RISC-based PICs. The reality, however, is that the average robot hobbyist lacks the programming skill and development time to invest in custom PIC design.

Recognizing the large market for PIC alternatives, a number of companies have come out with BASIC Stamp look-alikes—some of which are pin-for-pin equivalents, and many cost less than the Stamp or offer incremental improvements. And a few have attempted to break the BASIC Stamp mold completely by offering new and unique forms of programmable microcontrollers.

One fresh face in the crowd is the OOPic (pronounced "OO-pick"). This newcomer was designed by a NASA engineer and uses *object-oriented* programming rather than the "procedural" PBASIC programming found in the



This fire-fighting robot, built by OOPic developer Scott Savage, uses three OOPics wired together in a network to control the machine's central command, sensors, and locomotion.



Programs are written for the OOPic using a Windows-based software development platform. You open, save, debug, and compile your OOPic programs using pull-down menu commands.

BASIC Stamp. OOPic—which is an acronym for Object-Oriented Programmable Integrated Circuit—is said to be the first programmable microcontroller that uses an object-oriented language. The language used by the OOPic is modeled after Microsoft's popular Visual BASIC. And no, you don't need Visual BASIC on your computer to use the OOPic; the OOPic programming environment is completely stand-alone, and available free.

OOPic has built-in support for 31 input/output (I/O) lines. With few exceptions, any of the lines can serve as any kind of hardware interface—using what the OOPic documentation calls "*hardware objects*." Digital I/O lines can be addressed individually or by nibble (4 bits), byte (8 bits), or by word (16 bits). The OOPic also supports pre-defined objects that serve as analog-to-digital conversion inputs, serial inputs/outputs, pulse-width modulation outputs, timers/ counters, RC servo controllers, and 4×4-matrix keypad inputs. The device can even be networked with other OOPics, as well as with other components that support the Philips I²C network interface.

The OOPic comes with a 4K EEPROM for program storage, but memory capacity can be expanded to 32K, which will hold some 32,000 instructions. The EEPROM is "hot swappable," meaning that you can change EEPROM chips even while the OOPic is on and running. When a new EEPROM is inserted into the socket, the program stored in it is immediately started.

Additional connectors are provided on the OOPic for add-ins such as floating point math, precision data acquisition, DTMF/modem/musical-tone generator, digital thermometer, and even a voice synthesizer (currently under development). The OOPic's hardware interface is an open system; the I²C interface is published by Philips, allowing any IC that uses the I²C interface to "talk" to the OOPic.

While the hardware capabilities of the OOPic are attractive, its main benefit is what it offers robot hackers: Much of the core functionality required for robot control is already embedded in the chip. That'll save you time in writing and testing your robot control programs. Instead of several dozen lines of code to operate an RC servo, which is the case with the BASIC Stamp, you need about four lines when programming the OOPic.

A second important benefit is that OOPic's various hardware objects are multitasking, which means they run independently and concurrently of one another. You might command a servo in your robot to go to a particular location. Just give the command in a single statement; your program is then free to activate other functions of your robot—such as move another servo, start the main drive motors, and so forth. Once started by your program, all of the functions are carried out autonomously by the objects embedded within the OOPic. That simplifies the task of programming and makes the OOPic capable of coordinating many hardware connections at the same time.

Working with Objects and the OOPic

Mention the word "object-oriented programming" to most folks and they freeze in terror. Okay, maybe that's an exaggeration, but object-oriented programming seems like a black art to many, full of confusing words and complicated coding techniques. Fortunately, the OOPic avoids the typical pitfalls of object-oriented programming. The OOPic chip currently supports an easy-to-use programming language modeled directly after Microsoft Visual BASIC, so if you already know VB, you'll be right at home with the OOPic. Future versions of the OOPic software development platform will support C and Java syntax, for those programmers who prefer those languages.

The OOPic VB-like language offers some 41 programming commands. Not many commands, actually, but it's important to remember that the OOPic doesn't derive its flexibility from the BASIC commands. Rather, the bulk of the functionality of the chip comes from its built-in 31 objects. Each of these objects have multiple *properties*, *methods*, and *events*. You manipulate the OOPic's hardware objects by working with those properties, methods, and events; the BASIC commands are used for program flow.

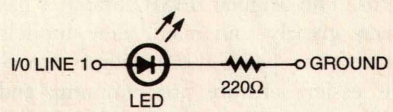


Fig.1. The OOPic can source or sink up to 25 mA/per I/O line. This sample circuit drives an LED directly. Transistors or bridges are needed when driving a large relay or a motor.

Here's an example OOPic program written in the chip's native BASIC language. I'll review what each line does following the code sample. This short program flashes a red LED on and off once a second. Figure 1 shows how to connect the LED and a current-limiting resistor to I/O line 1 (pin 7 on the I/O connector) of the OOPic.

```
Dim RedLED As New oDio1

Sub Main()
RedLED.IOLine = 1
RedLED.Direction = cvOutput
Do
   RedLED.Value = OOPic.Hz1
Loop
```

```
End Sub
```

These lines comprise a complete, working program. Here's the program broken down:

```
Dim RedLED As New oDio1
```

The Dim statement creates a new *instance* of a particular kind of digital I/O object. That I/O object, referred to as *oDio1*, has already been defined within the OOPic. All of the behaviors of this object have been pre-programmed; your job is to select the behavior you want and activate the object. Note that all of the OOPic's object names start with a lower-case letter O, such as oDio1, oServo, and oPWM.

```
Sub Main()
        ...
End Sub
```

The main body of every OOPic program resides within a subroutine called Main. OOPic BASIC permits you to add additional subroutines to your program, but every program must have a Main subroutine. As with Microsoft's Visual BASIC, you refer to subroutines by name.

```
RedLED.IOLine = 1
RedLED.Direction = cvOutput
```

Those two lines set up the I/O line connected to the RedLED object. In this case, we've defined that the RedLED object is connected to I/O line 1, and that this object will serve as an output (*cvOutput* is a pre-defined constant; you don't need to define its value ahead of time). All digital I/O lines can be defined as either input or output. The OOPic does not reserve certain lines as outputs, and others as inputs.

```
Do
   RedLED.Value = OOPic.Hz1
Loop
```

The statement *RedLED.Value = OOPic.Hz1* makes the LED flash once a second. The Do loop is used to keep the program running. Without that loop, the LED would flash once, and the program would end. Note the *OOPic.Hz1* value that is assigned to the RedLED object: *OOPic* is a built-in "system object" that is always available to your programs. One of the properties of the OOPic objects is *Hz1*, which is a one-bit value that changes the state of an I/O line (goes from high to low) once a second. Table 1 describes other properties of the OOPic system object you may find useful.

TABLE 1—PROPERTIES OF THE OOPic SYSTEM OBJECTS

OOPic Property	What It Does
ExtVRef	Specifies the source of the voltage reference for the analog to digital module.
Hz1	1-bit value that cycles every 1 Hz.
Hz60	1-bit value that cycles every 60Hz.
Node	Used when two or more OOPics "talk" to each other via the I^2C network. A Node value of more than 0 is the OOPic's I^2C network address.
Operate	Specifies the power mode of the OOPic.
Pause	Specifies if the program flow is suspended.
PullUp	Specifies the state of the internal pull-up resistors on I/O lines 8–15.
Reset	Resets the OOPic.
StartStat	Indicates the cause of the last OOPic reset.

Using and Programming the OOPic

Other than a 6–12 volt DC power source no other components are required to begin using the OOPic. For adequate current handling, if you want to use battery power, I suggest you use a set of eight Alkaline "AA" batteries in a suitable holder. The OOPic Starter Package comes with a nine-volt transistor battery clip; you can use this clip with RadioShack's 270-387 eight cell "AA" battery holder. The holder has connectors for the transistor battery clip.

Programs are developed for the OOPic using a proprietary but free development software. The development software works under Windows 9x and NT, and self-installs all necessary system files.

To program the OOPic you connect a cable between the parallel port of your PC and the programming port of the OOPic. The programming cable is provided as part of the OOPic Starter Package ($49), or you can make your own following the instructions provided on the OOPic home page (*www. oopic.com*). Once you've written a program in the development software, you then compile and download it through the programming cable. The OOPic is then ready to begin executing your program. Because the OOPic stores the downloaded program in non-volatile EEPROM, the program will remain in the OOPic's memory until you erase it and replace it with another.

ON THE WEB

OOPic Home Page
www.oopic.com/
The OOPic retails for $39 (the OOPic Starter Kit is $49, and includes programming cable and battery clip).

BASIC Stamp
www.parallaxinc.com/

Philips I^2C Component Network Interface
www-us2.semiconductors.philips.com/i2c/

OOPic Objects Ideal for Robotics

Though the OOPic is meant as a general purpose micro-controller, many of its objects are ideally suited for use with robotics. Of the built-in objects of the OOPic, the aA2D, oDio*x*, oKeypad, oPWM, oSerial, and oServo objects are probably the most useful for robotics work. In the descriptions below, the term *properties* refer to behaviors of an object, such as reading or setting the current value of an I/O line.

Analog-to-Digital Conversion—The oA2D object converts a voltage present on an I/O line and compares it to a reference voltage. It then generates a digital value, which represents the percentage of the voltage in relation to the reference voltage. The Operate property of the oA2D object initiates the conversion, and the Value property is updated with the result of the conversion.

There are four physical A2D circuits implemented within the OOPic, available on I/O lines 1 through 4.

(Continued on page 66)

JOHN IOVINE

Piezo-Film Transducers

Piezo (pronounced pe'azo) electric film, despite being around for a number of years, is not used much by electronic hobbyists. The piezoelectric effect was discovered in 1880 by Pierre Curie and his brother Paul-Jean using Rochelle salt. The piezoelectric effect is a phenomenon that allows certain crystalline or ceramic materials to act as a *transducer* at audio and radio frequencies. When subjected to mechanical stress (bending, flexing, *etc.*), piezoelectric material generates an electrical current. On the flipside, when subjected to an electric voltage, piezoelectric materials vibrate, producing sound or ultrasound.

The piezoelectric processes can be found at work in the most obscure places. For instance, the bones that make up the human skeletal system exhibit piezoelectric properties. That is to say, charges—which help keep the skeletal system healthy—are generated when bones are stressed through normal activity and movement. Medical doctors, recognizing the potential, are presently using that knowledge to help bones knit in difficult breaks and fractures, which are common in elderly patients. For that reason, the medical community recently began using an ultrasound device in the area of the break. When ultrasound is directed toward the fracture site, the vibrations generated enhance the knitting of bone material.

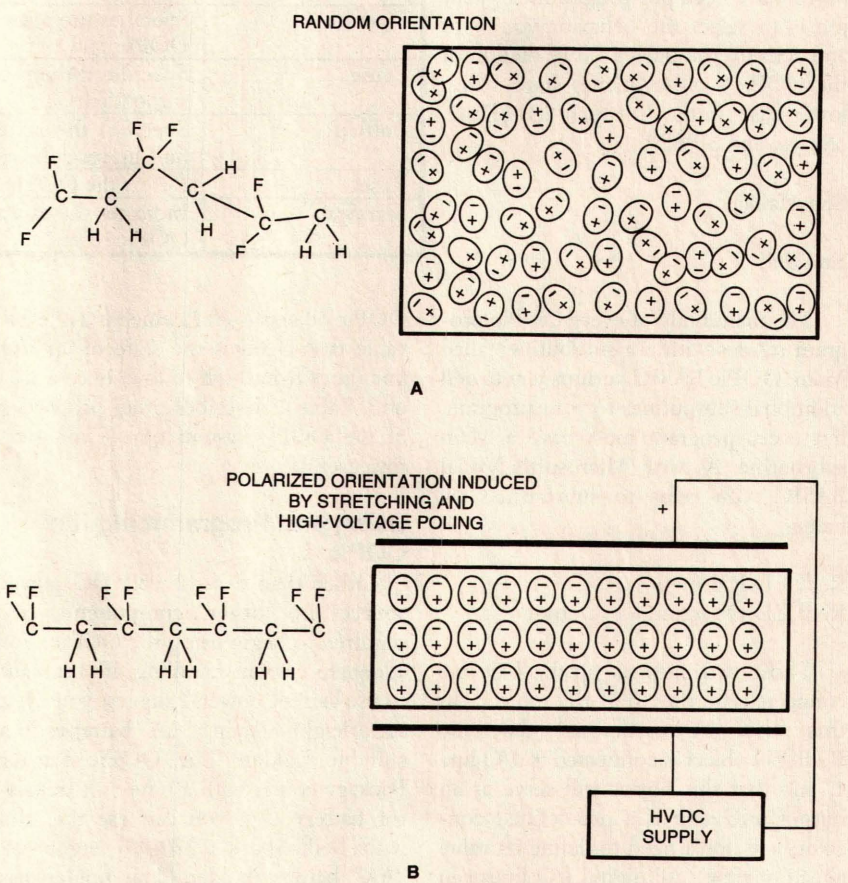


Fig. 1. In its natural state, the molecular structure of the plastic material is randomly oriented, as illustrated in A. Stretching the film polarizes and aligns the molecular structure of the plastic (as shown in B), producing an extremely thin and flimsy film.

Piezoelectric Film Properties

Piezoelectric film is really fun material to play with, and a great way to learn about piezoelectric effect. Piezoelectric materials are made of polyvinylidene fluoride plastic (hydrogen, fluoride, and carbon) film. The film is endowed with piezoelectric properties by stretching the plastic while it is placed under a high-poling voltage. As shown in Fig 1A, in its natural state, the molecular structure is randomly oriented. Stretching the film polarizes and aligns the molecular structure of the plastic (as shown in Fig. 1B). At this point, the raw film is extremely thin and flimsy.

As the process continues, a thin layer of conductive nickel-copper metal is deposited on each side of the film. The nickel copper makes the piezoelectric film resemble aluminum foil. While the lamination inhibits the film's sensitivity to vibration, that factor is far outweighed by the greatly increased ruggedness of the transducer. The resulting piezoelectric film is lightweight and very flexible; it can be easily cut with a scissors and glued to shaped designs. Finally, electrical connectors are attached to the conductive coating. (**Note:** Although most transducers already have wire leads connected to the film, if one needs to make a connection to raw film, you should use silver epoxy or conductive copper tape.)

Piezoelectric film has a voltage output about ten times greater than ceramic material. It is mechanically strong and impact resistant. One disadvantage to

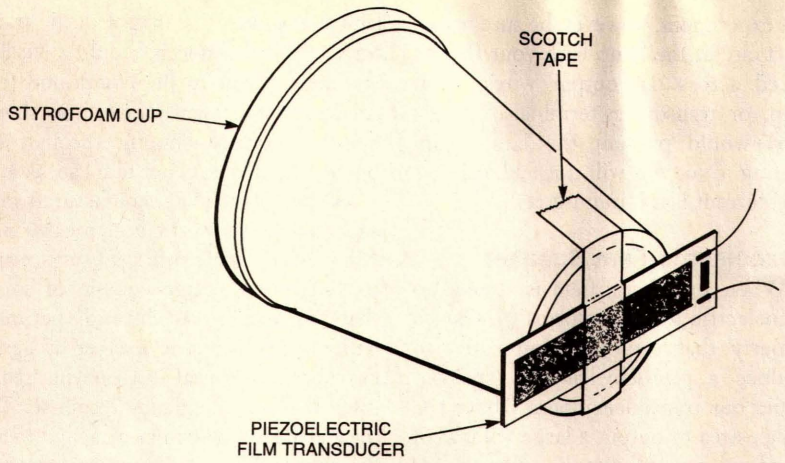


Fig. 2. In this experiment, a 0.63- × 2.9- × 0.008-inch laminated piezoelectric film transducer is converted into a microphone by scotch taping it to the bottom of a Styrofoam cup.

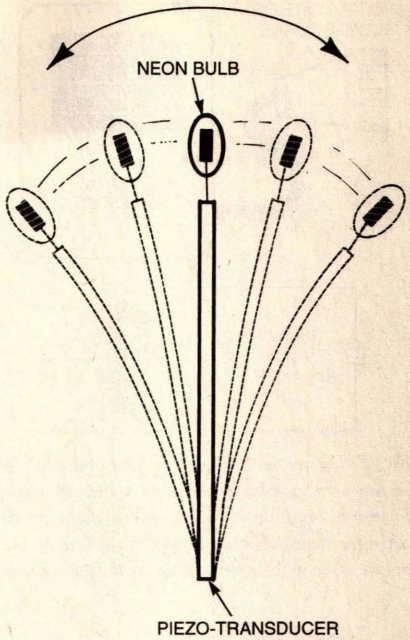


Fig. 4. Flicking the transducer back and forth, as illustrated here, causes the neon lamp to strobe as long as the motion continues.

piezoelectric film is that it makes a rather weak electromechanical transmitter when compared to ceramic materials.

Other film attributes include:

Wide Frequency Range: 0.001 Hz to 1 GHz.

Low Acoustical Impedance close to water and human tissue. (This enhances efficiency for sonar and ultrasound imaging.)

High dielectric strength.

Good mechanical strength.

Moisture resistant, inert to many chemicals.

Piezoelectric film produces a greater voltage output when an impact stretches rather than compresses the film.

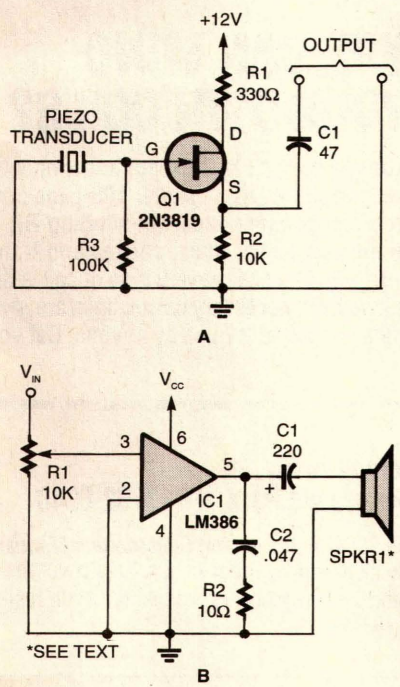


Fig. 3. The signal produced by the Styrofoam microphone can be magnified by feeding the output of the "microphone" to a FET-based preamplifier, like that shown in A. The signal can then be boosted further by applying the putout of the preamp to a simple audio amplifier, like that shown in B.

Quick Microphone

For our experiments we'll use a laminated piezoelectric film "transducer," with an overall size of 0.63 × 2.9 × 0.008 inches thick (including laminate). The transducer can be turned into a microphone by taping it to the bottom of a Styrofoam cup, as shown in Fig. 2. The output of the microphone can be magnified by feeding the output of the "microphone" to a FET-based preamplifier, like that shown in Fig. 3A. The signal can then be boosted further by applying the putout of the preamp to a simple audio amplifier, built around an LM386 audio-power amplifier (see Fig. 3B) or other inexpensive audio amplifier (such as the RadioShack unit listed in the Parts List).

PARTS LIST FOR THE FET PREAMP (FIG. 3A)

Q1—2N3819 general-purpose field-effect transistor (RS# 276-2035 or equivalent)
R1—330-ohm, 1/4-watt, 5% resistor
R2—10,000-ohm, 1/4-watt, 5% resistor
R3—100,000-ohm, 1/4-watt, 5% resistor
C1—47-μF, 12-WVDC, non-polarized, electrolytic capacitor
Piezo transducer, printed-circuit board or perfboard materials, hook-up wire, solder, hardware, *etc.*

Neon Light Demonstration

The piezoelectric-film transducer can easily output 60–100-volt pulses. If the output is connected to an oscilloscope, flicking the end of the transducer can generate pulse heights reaching 100 volts or more. If an oscilloscope is not available, the output can be demonstrated by soldering a small neon lamp to the output leads of the transducer. The leads from the transducer should be about 1-

PARTS LIST FOR THE AUDIO POWER AMPLIFIER (FIG. 3B)

IC1—LM386 audio-power amplifier, integrated circuit (RS# 277-1008)
R1—10,000-ohm, 1/4-watt, 5% resistor
R2—10-ohm, 1/4-watt, 5% resistor
C1—220-μF, 25-WVDC, electrolytic capacitor
C2—0.47-μF ceramic-disc capacitor
SPKR1—Piezoelectric film speaker (see text)
Printed-circuit board or perfboard materials, hook-up wire, solder, hardware, *etc.*
Note: The following items are available from Images Company, 39 Seneca Loop, Staten Island, NY 10314; Tel. 718-698-8305; Piezoelectric transducer (part # PZ-03) for $7.50; Piezoelectric speaker for $30.00; miniature step-up transformer with data sheet for $7.50; and neon lamp $1.

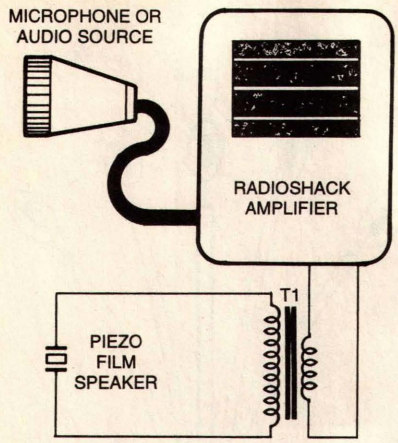


Fig. 5. The output of a small audio amplifier, as shown here, can be fed through a step-up transformer to boost the signal to a level sufficient to drive the transducer. Any sound picked up by the microphone will be reproduced by the transducer.

inch long.

Flicking the transducer back and forth, as illustrated in Fig. 4, will cause the neon lamp to strobe as long as the motion is continued. If you have any difficulty seeing the neon lamp flash, bring the apparatus into a darkened room and repeat the experiment.

The neon lamp will also flicker by simply bending the transducer. If you try that experiment, however, be sure not to short circuit the lamp with your fingers placed across the output wires, neon lamp, or transducer terminals. Such a short would prevent the lamp from lighting. (No, you will not feel a shock. The current is too minuscule.)

Piezoelectric Film Speaker

When an electric field is applied to piezoelectric film it deforms (flexes)—a property that can be manipulated to produce a piezoelectric-film speaker. While our transducer doesn't have the surface area to output a large volume of sound, we can still squeak a few sounds out of it. The material requires a high-voltage audio signal to work. To accomplish that, the output of your sound source (audio amplifier) must be fed through a step-up transformer before its application to the piezoelectric film.

As illustrated in Fig. 5, the output of a small audio amplifier, which is available from RadioShack, is fed through its ⅛-inch external speaker jack to a step-up transformer, T1. If you prefer to use a home-built amplifier, say, one based on the LM386 audio-power amplifier (or its equivalent), connect the output of the amplifier to the step-up transformer in a similar manner. The output of the transformer is then connected to the transducer. Apply power to the circuit and then speak into the microphone. You should hear your voice coming through the homemade piezoelectric film "speaker."

A speaker can be manufactured from a piece of piezoelectric film, measuring 3 × 6 inches. That's sufficient surface area to generate a better volume of sound than the smaller transducer. Experiment with the piezoelectric speaker by gently curving the material and see what radius gives the best frequency response. The piezoelectric film can be attached to air- or helium-filled balloons to create a unique speaker.

Piezoelectric film is made into a variety of sizes and shapes for all manner of applications. For example, there are piezoelectric switches, transducers, buzzers, coax cables , and the like on the market. And the future is sure to give rise to many more.

Well, that's about all the space allotted to us for this month's experiments. But be sure to join us next time around. In the meantime, why not perform a couple of piezoelectric experiments, and let us know how things worked out. Good luck. P

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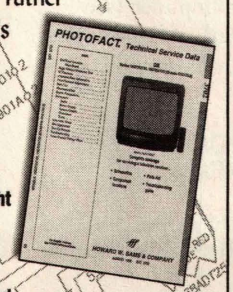

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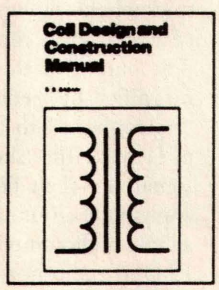

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TECH MUSINGS

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Temperature Measurements, Thermocouple Fundamentals, Gambling Simulation, Working With Newsgroups, and More

We sure seem to have lots of superb new ways to sense temperature lately. Dallas Semiconductor has all sorts of low-cost, linear, self-conditioning, single-chip solutions that work very well over "normal" temperatures in "friendly" environments. Some log or store their own data.

A few examples now include their DS1621, DS1624, and DS1820. Details on those and similar offerings from Analog Devices, Holtek, National, Maxim, Philips, Toko, and others can be found at *www.questlink.com* or at *www.chipcenter.com*. Those sites also offer application notes and samples.

But there are times when you need to measure extreme temperatures, are stuck with a nasty environment, or have to reuse older industrial test gear. For those uses, the traditional thermocouples are often a good choice. So, we seem to be way past due for an introductory...

Thermocouple Review

If two dissimilar metals or alloys are placed in contact with each other, the Seebeck Effect generates a small voltage that is dependent upon the absolute contact temperature. For instance, copper contacting a constantan alloy (an alloy of 60% copper and 40% nickel that is used extensively in strain gauges) will generate around seven millivolts at room temperature. Voltage increases by 40 microvolts per degree C or so as the temperature changes. The voltage versus temperature is fairly linear over limited ranges. Much of the remaining nonlinearity is well known, stable, monotonic, and easily corrected.

A thermocouple is simply a sensor or a probe made from two dissimilar metals or alloys that are in contact with each other. Figure 1 shows a typical thermocouple setup. Long ago and far away, thermocouples were used in pairs. The first sensor in the series bucking pair was placed in an ice bath and the temp difference was sensed. In most new systems, a cold reference of a few millivolts is often substituted instead.

At one time, amplifiying an offset microvolt-sized DC signal was a bear of a problem, but we now have single chips that can do the whole job from Analog Devices, Dallas, Linear Technology, Maxim and others that make the task hassle free.

Because any two contacting metals do generate a thermoelectric voltage, you have to be extra careful how you connect a thermocouple to a system. The simplest and safest method is to use identical conductor materials all the way through. Every time you add a connector or new conductors, you add unwanted thermoelectric offsets. All of those offsets must be properly and fully accounted for.

Thermoelectric potentials are all compared against lead. Table 1 shows the microvolts per degree that you can expect from various common materials along with the first-order linearity correction. To find how any junction behaves, add up the positive and negative lead results.

Using those figures should tell you that a cold-junction, compensated, type "T" copper-constantan thermocouple should output

-5.54 millivolts at -200 C
-3.35 millivolts at -100 C
+0.00 millivolts at 0 C
+4.28 millivolts at 100 C
+9.29 millivolts at 200 C
+14.9 millivolts at 300 C
+20.9 millivolts at 400 C

As you can see, the linearity seems pretty good but not great. The easiest way to correct for that is with a table-lookup readout that is stored in an EEPROM. That exciting Maxim MAX1457 and its offspring seem especially adept at that.

Because tin has low thermoelectric

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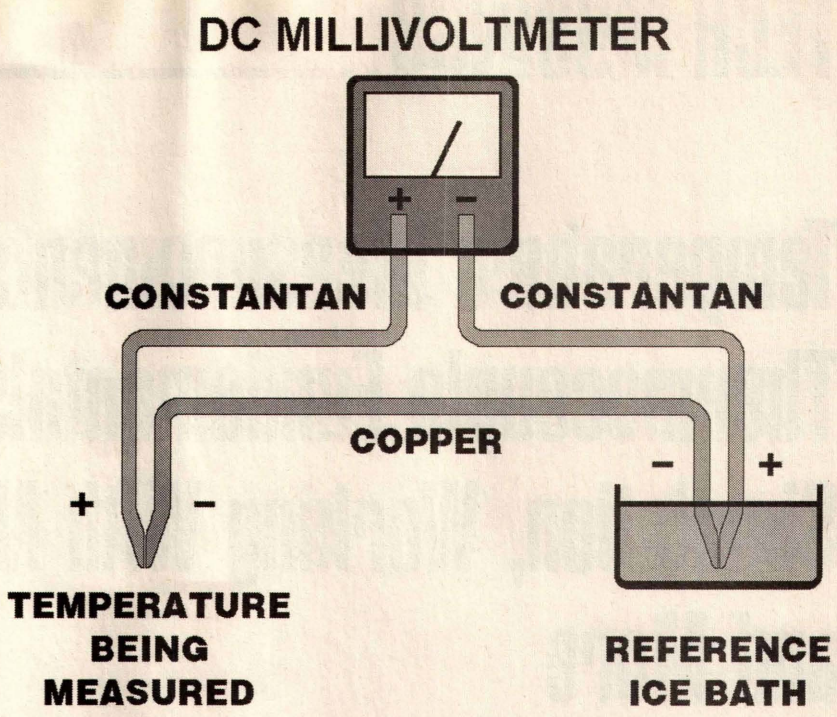

Fig. 1. Thermocouple temperature measurement makes use of the Seebeck Effect to create millivolt-sized signals proportional to temperature differences. The traditional "cold junction" shown here is usually replaced with a small and precise voltage reference.

potentials, solder will behave pretty much the same as pure lead. There are several different popular thermocouples in general use. They differ in their output voltage, useful temperature range, lead color coding, linearity, stability, and the types of chemical environments that they must survive in. A few of those are summarized in Table 2.

The type "J" thermocouple is the most popular one for everyday applications, while the type "T" gives you the best stability and performance for lower-industrial on down to liquid-nitrogen (cyrogenic) temperatures. A type "K" thermocouple might be a good choice for a high temperature kiln.

A big hidden "gotcha" that will nail you every time: US thermocouples have red as their negative lead! Watch for that detail.

Fundamental thermoelectric properties can be found in the *Handbook of Chemistry and Physics*. Further details can be found on my Web site at *www.tinaja.com/amlink01.html*. Trade journals include *Measurement & Control* or *Sensors*. *Sensors & Actuators B* is one scholarly journal.

Thermocouple costs go from a few to several hundred dollars, depending on their type and use environment. Figure 2 shows us a stainless-steel-immersion unit. A leading supplier is Omega, and Watlow is a second. Useful tutorials can be picked up on their respective Web sites: *www.omega.com/temperature* and *www.watlow.com/ref/index.html*. Good stuff here.

Another useful tutorial Web site is found at *www.engr.orst.edu/~aristopo/temper.html*.

I've got lots of type "T" premium long-leaded, lower-temperature-range thermocouples, precision thermistors, temperature-color strips, and Fluke digital-temperature instrument bargains at *www.tinaja.com/barg01.html*.

Thermoelectric Power?

Can thermocouples or thermopiles be used to generate power? Well, sort of, but they are so inefficient that they are limited to very special uses. Using

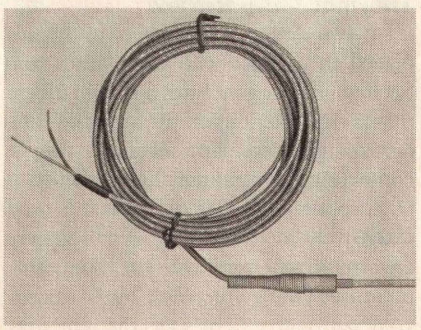

Fig. 2. A typical thermocouple.

TABLE 1

THERMOVOLTAGES GENERATED BY POPULAR METALS AND ALLOYS

MATERIAL	μV/DEGREE	NONLINEARITY
Aluminum	–0.38	–0.00010
Antimony	+35.58	+0.145
Bismuth	–43.68	–0.465
Brass	+0.710	+0.00561
Cadmium	+3.059	+0.0285
Carbon	+11.056	+0.0358
Cobalt	–10.71	–0.0570
Constantan	–38.105	–0.0888
Copper	+2.76	+0.0122
Germanium	+302.5	+0.725
Gold	+2.90	+0.0068
Indium	+2.40	+0.00190
Iron	–51.34	–0.204
Lead	0.0000	0.0000
Magnesium	–0.201	+0.002572
Mercury	–8.81	–0.0333
Nickel	–19.067	–0.03022
Nichrome	+25.0	+0.02643
Palladium	–7.409	–0.03922
Platinum	–3.038	–0.03248
Rubidium	–8.26	–0.0302
Silicon	–408.2	–0.4696
Silver	+2.50	+0.0115
Tin	+0.0684	+0.000038
Tungsten	+1.594	+0.0341
Zinc	+3.047	–0.0099

today's known materials, any bunch of thermocouples grouped to recover, say, exhaust heat from a car would never come remotely near to getting back all of the energy used in manufacture—let alone being able to pay for themselves.

But thermoelectrics can (although rarely) be applied for "Uh, compared to what?" needs for modest quantities of power, such as on an arctic expedition, for precision power measurement, or to generate enough current from a gas flame to run a safety shutoff.

There is a second thermoelectric response known as the Peltier effect. This applies the bulk-carrier-migration property of bismuth telluride or other special semiconductors. Those devices rarely see use for cooling devices. Again, they are hopelessly inefficient with known materials, so they are restricted to the most arcane of low-power uses. More on the Peltier effect is found in *http://www.tinaja.com/glib/ratholes.pdf*.

Some Thermoelectric Books

I've gathered together some books about thermocouples, thermoelectrics, and temperature measurement in general for you as this month's resource sidebar. You can find more details or order these titles by going to *www.tinaja.com/amlink01.html*.

The Gambler's Ruin

A novel little simulation program called the *Gambler's Ruin* appears as a PostScript-as-language example in Listing 1. Suppose you and I start with ten coins each and run a "fair" coin-flipping game till somebody has all of the coins. Who wins?

On the average, you would expect to win half of the time. Now, we will make a seemingly minor change. The house starts with 100 coins and the "mark" has only 10. Now who wins?

Surprisingly, the mark now wins less than ten percent of the time. If the house starts with 10,000 coins, the mark never wins! At least not so as you'd ever notice. The mark may temporarily get way ahead, but they never win. The point being that any mark who bets against everything that can be gambled on is absolutely certain to lose big time.

That model plays out two million games. Every thousand games, the mark's winnings are reported to the PS log file as a percentage. You can easily change each side's coin starts or the number of games. As usual, you enter the program in any word processor or editor and then route it to Acrobat Distiller or GhostScript. The ready-to-run code is at *http://www.tinaja.com/post01.html*.

favicon.ico ?

The tiniest details seem to make a profound difference between a good Web site and a great one. I was using my GRAB404.PS log error snooper at *www.tinaja.com/weblib01.html* and recently began picking up all sorts of "404-file not found" errors on a strange beastie called "favicon.ico."

It turns out these were folks trying to save my site as one of their Win98 favorites. Apparently you'll have to give them a 16x16 bitmapped icon named favicon.ico to let that happen. A Web search using the "hotbot" button on my Web page turned up all sorts of useful favicon utilities.

The one I ended up using was the interactive online Java service up at *www.favicon.com* The process is fun, quick, and simple. You create an icon online in real time using their Paint-style pixel editor. They then email it back to you—free.

You do have to make certain that it is renamed favicon.ico and FTP it to your Web site. Note that any icon file errors might cause your users serious problems, so it is best to use a free service of this type.

Thoughts on Newsgroups

I'm still amazed how many of my helpline callers still have never heard of Usenet newsgroups and do not tap this highly useful resource.

A newsgroup is an unmoderated special-interest chat room or message forum. There are many tens of thousands to pick from. Examples of newsgroups that I personally use are:

comp.lang.postscript
comp.systems.apple2
comp.text.pdf
sci.electronics.misc
sci.electronics.design
sci.electronics.repair
sci.electronics.equipment
sci.energy.hydrogen
sci.engineering.illumination
sci.math
sci.optics
sci.physics

Newsgroups are useful for helping "newbies," solving strange problems, matching up buyers and sellers for arcane equipment, or for picking up all of the secret insider stuff of software bugs, defects, or "gotchas."

There are several methods to find

TABLE 2
SOME PROPERTIES OF POPULAR THERMOCOUPLE JUNCTIONS.

Type	Positive Composition	Negative Composition	Features
Type B	platinum 30% rhodium	platinum 6% rhodium	Easily contaminated. Requires careful protection. Used at higher temperatures +1400 to +1700 C, +2500 to +3500 F.
Type C	tungsten 5% rhenium	tungsten 26% rhenium	Works at extremely high temperatures. No oxidation resistance. Needs vacuum, hydrogen, or inert atmospheres +1650 to +2315 C, +3000 to +4200 F.
Type E	chromel	constantan	Highest output of base. Does not corrode at cyrogenic temperatures +95 metal thermocouples to +900 C, +200 to +1650 F.
Type J	iron	constantan	Most popular general use thermocouple. Can "rust" in oxidizing environments+95 to +760 C, +200 to +1400 F.
Type K	chromel	alumel	Good kiln thermocouple in oxidizing atmospheres+95 to +1260 C, +200 to +2300 F.
Type N	Nicrosil	Alumel	Resists sulfur. Kiln usable +650 to +1260 C, +1200 to +2300 F.
Type R	platinum 13% rhodium	pure platinum	For high temperature oxidizing atmospheres. Easily contaminated+870 to +1450 C, +1600 to +2640 F.
Type S	platinum 10% rhodium	pure platinum	Laboratory standard. Easily contaminated+980 to +1450 C, +1800 to +2640 F.
Type T	constantan	copper	Most stable at cyrogenic temperatures. Useful from –200 to +350 degrees C, -330 to +660 F.

newsgroups. Your ISP might already offer them in their basic service to you. They might charge a nominal ($0.50 to $3) monthly surcharge. If you are using an ISP, just use your mail and news client—like Netscape Mail's "Subscribe" button—to generate a list of 18,000 to 30,000 or more groups. Then click on any of the groups that you might find to be of interest. Finally, double check on the traffic and make sure that the content and usefulness are as you thought.

Alternately, you might make good use of *www.deja.com/home_ps.shtml* for newsgroup access. That service also archives everything that has ever been said about anything. While Deja is more ungainly than direct access, it should easily reach even the most obscure of groups.

Deja is also especially useful to tell you which groups may be of help to you. The answer often is already there. You can also scope out what another newsgroup author's posting history has been. Deja is also conveniently reached from my deja button over at *www.tinaja.com*.

You can also start your own Deja forum. Details are on their site.

Since anybody can participate, the quality varies all over the lot. Some newsgroups yield nothing but porno links and really dumb get-rich-quick schemes. Others rarely get above the intellectual level of some fifth-grade playground brawl. Yet others simply do not have nearly enough traffic to be worth bothering with.

Unless their name ends in ".marketplace," direct selling or blatantly obvious promotion are both no-no's on most newsgroups, especially when they're also off topic. There are secret incantations that insiders use to sell their stuff without offending too many people. If you precede your message with "an:" that's the signal for an announcement of a product or service that is available. "fs:" handles for sale and the new "fa:" takes care of auctions like eBay.

It is also usually permissible to add a commercial "please visit" tagline in the message or in your sig file. Keep every-

LISTING 1

```
% THE "GAMBLER'S RUIN" IN POSTSCRIPT
% ===================================
% Copyright c 2000 by Don Lancaster and Synergetics, Box 809, Thatcher, AZ, 85552
% 520-428-4073 don@tinaja.com http://www.tinaja.com
% Consulting services available per http://www.tinaja.com/info01.html
% All commercial rights and all electronic media rights fully reserved.
% Personal use permitted provided header and entire file remains intact.
% Linking is welcome. Reposting expressly forbidden.
% This PostScript-as-language example simulates the "gambler's ruin".
% It shows how bet outcomes change dramatically when one side has got
% significantly more resources than the other.
/win 0 def % mark's wins
/loss 0 def % mark's losses
/housecoins 100 def % house initial stake
/markcoins 10 def % mark initial stake
/random {rand 65536 div 32768 div mul cvi} def % as in — 6 random —
/play {markcoins {2 random % flip coin
1 ge {1 add}{1 sub} ifelse % adjust mark's stash
dup 0 lt {pop /loss loss % exit if loss
1 add store exit}if
dup markcoins housecoins add gt % exit if win
{pop /win win 1 add store exit}if
}loop} def % play till win or lose
2000 { % start 2,000,000 play loop
1000 { play} repeat % play 1000 games
win loss win add div % find mark's wins
100 mul == flush % convert to percent
} repeat % and then report
% In this example, the mark should win just under 10% of the time.
```

thing super short.

Several tips: Never respond to any person who is using some alias or is hiding their true address. Several of those individuals seem clearly a few chips shy of a full board. Should you offend them, at least a few have been known to anonymously tell your boss about all your outstanding kiddyporn warrants, whether they exist or not. Sad but true.

Use Deja News to make sure you are not asking something that has already gotten answered many times. Think about all of your messages before you post them. Always double check your spelling. Pause before clicking! Always ask yourself the key question "My message is now going into Deja News where it will stay forever. Do I really want to do this?"

Never use binary files or any other attachments of any sort. If you need more content, use links instead.

Always respond to your group and never to the individual. Although the group can be influenced, often the individual can not. Be sure to let the other side post the last message.

Always ignore "flamers" (those who seem rude or insulting) and "trolls" (those that intentionally use outrageous posts to yank your chain).

Repeated responses should rarely exist at all. But, if you feel you must, always take them offline and make use of private email instead.

The first way to deal with flamers and trolls is to use your killfile so that they don't even appear on your screen or simply by never so much as reading anything that they post. The second is a sneaky trick I call deraveling a troll. Let somebody else respond to the thread, then respond to the respondee. Carefully remove any and all previous mention of the troll or their points. Redirect the thread into benign and informative group tutorial material, useful links, or whatever else works.

A second useful troll defense is to strengthen the middle. Post factual and relevant mainstream information. Use sources with lots of solid references—like Tech Musings. Do so often. That will make the sideshows painfully obvious. Eventually, all of the two-headed calves should leave of their own accord.

Note that extreme politeness and professional decorum is demanded in most .sci newsgroups. The intent of .sci groups is to purposely seek out criticism and negative comment.

As the old saying goes, "Iffen yew cain't hunt with the big dawgs, stay on the porch."

It is also wildly inappropriate to post off-the-wall pseudoscientific or other unsupportable claims to any .sci group. All that does is confirm that you are a total idiot. Use an .alt group (such as *alt.energy.hydrogen* or *alt.energy.overunity*) instead.

More on newsgroups can be found at *http://www.tinaja.com/glib/resbn60.pdf* and *http://www.tinaja.com/glib/resbn73.pdf*.

NAMES AND NUMBERS

Advanced Circuits
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Aurora, CO 80011
800-289-1724
www.4pcb.com

Allegro Micro Systems
Box 15036
Worcester, MA 01605
508-853-5000
www.allegromicro.com

Analog Devices
PO Box 9106
Norwood, MA 02062
800-262-5643
www.analog.com

Dallas Semiconductor
4401 Beltwood Pkwy S.
Dallas, TX 75244
972-450-0400
www.dalsemi.com

Disc Makers
7905 N. Crescent Blvd.
Pennsauken, NJ 08110
800-237-6666
www.discmakers.com

Fibersense/Fog Horn
755 Dedham St.
Canton, MA 02081
781-830-9690
www.fibersense.com

Holtek/Holmate Technology
1342 Ridder Park Dr.
San Jose, CA 95131
408-573-8050
www.holtek.com

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035
408-432-1900
www.linear-tech.com

Maxim
120 San Gabriel Dr.
Sunnyvale, CA 94086
800-998-8800
www.maxim-ic.com

Micrel Semiconductor
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San Jose, CA 95131
408-944-0800
www.micrel.com

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Chandler, AZ 85224
480-786-7200
www.microchip.com

National Semiconductor
2900 Semiconductor Rd.
Santa Clara, CA 95052
800-272-9959
www.national.com

Omega Engineering
One Omega Dr.
Stamford, CT 06907
800-848-4286
www.omega.com

Philips
2001 W. Blue Heron Blvd.
Riviera Beach, FL 33404
407-881-3200
www.philips.com

Pressurex/SPI
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East Hanover, NJ 07936
800-755-2201
www.sensorprod.com

Stemgas Publishers
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Lancaster, PA 17608
717-392-0733

Synergetics
Box 809
Thatcher, AZ 85552
520-428-4073
www.tinaja.com

Toko
1250 Feehanville Drive
Mt Prospect, IL 60056
847-297-0070
www.tokoam.com

Watlow Controls
12001 Lackland Rd.
St Louis, MO 63146
800-4-WATLOW
www.watlow.com

Wavetek
11995 El Camino Real #301
San Diego, CA 92130
619-793-2300
www.netsv.com/wavetek

SOME SELECTED THERMOMETRY BOOKS

CRC Handbook of Thermoelectrics (D.Rowe)
Electronic Refrigeration (H. Goldsmid)
Fundamentals of Temperature Measurement (Robert Benedict)
Handbook of Temperature Measurement (Robin Bentley)
Industrial Temperature Measurement (Thomas Kerlin)
Measurement of Temperature and Humidity (W. Wylie)
Measurements in Flames (J. Chedaille)
Practical Thermocouple Thermometry (Thomas W. Kerlin)
Principles of Temperature Measurement (Thomas McGee)
Temperature Measurement (Amer Society for Testing)
Temperature Measurement (Bela Liptak)
Theory and Properties of Thermocouple Elements (D. Pollock)
Thermocouple Temperature Measurement (P.Kinzie)
Thermoelectric Materials (Marshall Sittig)
Thermoelectric Materials 1998: The Next Generation (T. Tritt)
Thermoelectricity: Theory, Thermometry, Tools (D. Pollock)
Use of Thermocouples in Temperature Measurement (ASTM)

For more book details, see *www.tinaja.com/amlink01.html*

New Tech Lit

Microchip Technology has recently started up a retail online store, which should once and for all eliminate the hassles in getting their great PIC chips, however obscure. Go to *www.microchip.com* for full details.

As we have seen before, just about any newer semiconductor sample can be gotten at *www.questlink.com* or at *www.chipcenter.com*. You can reach both sites through the appropriate buttons on my *www.tinaja.com* Web site.

From Toko, there are two new data books: *Power Conversion ICs* and *Coils & Filters*. From Allegro Microsystems, a new CD ROM data book on lots of Hall devices and interface circuits. From Micrel comes their new MIC502 fan management chip. Analog Devices has also released their New Products Update condensed data book.

One useful far infrared tutorial site is *www.intrel.com*. For HDTV info, see *web-star.com/hdtv/hdtvnews1.html*. Note that there's no "www" in that last URL.

The Web site for the Pyrotechnics Guild International can be found at *www.pgi.org/html*. You should get a real bang out of this one!

From Advanced Circuits comes a promotional CD on their printed-circuit production capabilities. CD-ROM manufacturing info is available from Disc Makers including all of those new business-card size 250-Megabyte CDs.

Details on fiber-optic gyroscopes appear in the free and aptly-named *Fog Horn* magazine from Fibersense Technology.

Stemgas Publishers offers a wide variety of books and other tricky-to-find info on steam tractors and other antique agricultural machinery.

From Sensor Products comes a new line of Pressurex Tactile pressure films. Their stuff changes color whenever you stress it, making for all sorts of great mechanical studies. Ranges go from 28 to 18,500 psi.

For most individuals and smaller-scale startups most of the time, any involvement with patents is virtually certain to end up as a net loss of your time, energy, money, and sanity. Find out why along with my tested and proven solutions in my "Case Against Patents" package as per my Synergetics ad or at *www.tinaja.com/patnt01.html*.

I've just added a whole load of really fine Wavetek 145 function generators, premium accelerometers, and robotic electric brakes to my bargain pages at *www.tinaja.com/barg01.html*. To get "cash-and-carry" tech research help, visit *www.tinaja.com/info01.html*.

As usual, most of the referenced items are in our Names & Numbers or Thermometry Books sidebars. Be sure to check there first before calling our no-fee US tech helpline. P

ROBOTICS WORKSHOP

(continued from page 57)

Digital I/O—Several digital I/O objects are provided in 1-, 4-, 8-, or 16-bit blocks. In the case of the 1-bit I/O object (named oDio1), the Value property of the oDio object represents the electrical state of a single I/O line. In the case of the remaining digital I/O objects, the Value property presents the binary value of all the lines of the group (4, 8, or 16, depending on the object used).

There are 31 physical 1-bit I/O lines that are implemented within the OOPic. The OOPic microcontroller offers six physical 4-bit I/O groups, three 8-bit groups, and one 16-bit group.

Keypad Input—The oKeypad object splits two sets of four I/O lines in order to read a standard 4×4-keypad matrix. The four row lines are individually and sequentially set low (0 volts) while the four column lines are used to read which switch is pressed within that row.

If any switch is pressed, the Value property of the Keypad object is updated with the value of the switch; a Received property is used to indicate that at least one button of the keypad is pressed. Once all keys are released, the Received property is cleared to 0.

Pulse Width Modulation—The oPWM object provides a convenient pulse-width modulated (PWM) output, suitable for driving motors (through an appropriate external transistor output stage, of course). The oPWM object lets you specify the I/O line to use—up to two at a time for PWM output—the cycle frequency, and the pulse width.

Asynchronous Serial Port—The oSerial object transmits and receives data at a baud rate specified by the Baud property, The baud rate can be either 1200, 2400, or 9600 baud. The oSerial object is used to communicate with other serial devices, such as a PC or a serial LCD display.

RC Servo Control—The oServo object outputs a servo control pulse on any I/O line. The servo control pulse is tailored to control a standard radio-controlled (RC) servo and is capable of generating a logical high-going pulse from 0 to 3ms in duration in $\frac{1}{36}$ms increments.

A typical servo requires a 5-volt pulse in the range of 0.66ms to 2.33ms in duration. This allows for a rotational range of 180 degrees. The duration of the control pulse is determined by setting the Value, Center, and InvertOut properties of the oServer object. The Value property controls the position of the servo while the Center property adjusts the control pulse time to compensate for mechanical alignment. An InvertOut property reverses the direction that the servo turns in response to the Value and Center properties.

That's all the room we have this month. Next time we'll continue our discussion of the OOPic, including the use of virtual circuits, which allow you to programmatically link together objects in the same way you'd physically connect electronic components to build a real-world circuit. We'll also present a basic project using the oServo object to control several RC servo motors. P

CHARLES D. RAKES

555 Applications

One of the most popular and universal integrated circuits to come down the solid-state highway is without a doubt the 555 oscillator/timer. There are several versions of the 555—available in single, dual, CMOS, *etc.* The 555, along with its dual cousin—the 556, which incorporates two 555 oscillator/timers into a single 14-pin DIP package—are probably the most popular versions. But coming up fast is a CMOS version of the 555, which draws much less power.

The 555 family is an excellent choice when an accurate timer or oscillator is required. In timing applications, a single external resistor-capacitor (RC) network is all that's required to set the chip's timing (delay) period. In a similar vein, when operated as an astable oscillator, only two resistors and a single capacitor are required to set the circuit's operating frequency. Standard single and dual versions of the 555 can source or sink up to 200 mA and are capable of driving almost all digital ICs. The CMOS version can sink up to 100 mA and source a maximum of 10 mA of current.

A Look At The 555

Figure 1 shows a functional block diagram of the 555 oscillator/timer. Note from the block diagram that that control-voltage terminal (pin 5, designated CV) is connected to the negative (−) input of comparator "A." In most 555 applications, the CV terminal is seldom used; it is often bypassed through a capacitor to ground. Also note that a voltage-divider network—comprised of three resistors stretching from the positive supply to ground—feeds a predetermined percentage of the supply voltage to the negative input of comparator "A" and to the positive input of comparator "B." Those two preset voltages, at the inputs of the two comparators, determine the circuit's switching point.

If the voltage at pin 5 is varied by way of an outside source, the circuit's timing changes, as well as the operating frequency. Increasing the voltage at pin 5 increases the charging time of the frequency-determining capacitor, thereby, lowering the circuit's operating frequency.

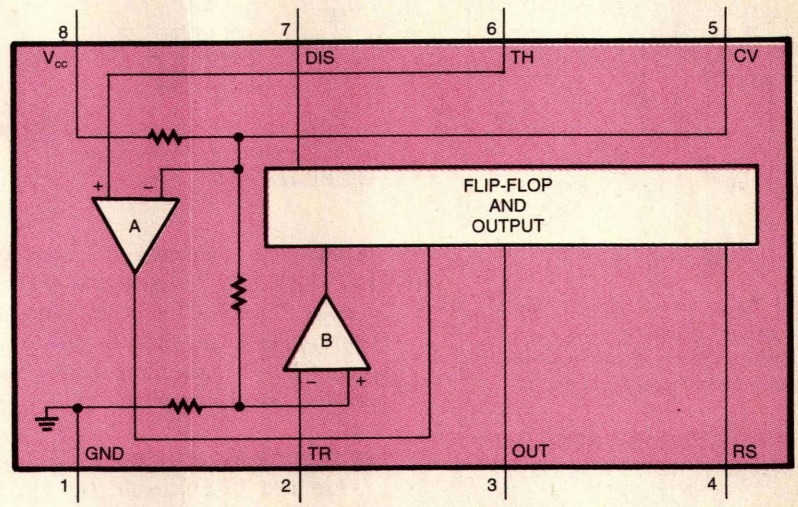

Fig. 1. This functional block diagram reveals that the 555 is made up of a pair of comparators, a flip-flop, an output circuit, and several resistors.

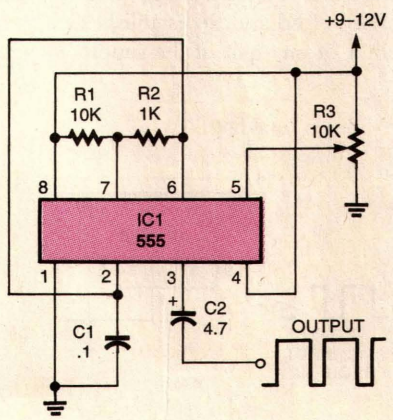

Fig. 2. In this schematic diagram of a basic 555 voltage-controlled oscillator, pin 5 of IC1 is connected to the wiper of a 10,000-ohm potentiometer (R3). The potentiometer is used to vary the voltage applied to the control-voltage input (pin 5), thereby altering the circuit's frequency of operation.

Lowering the voltage at pin 5 reduces the capacitor's charge time, increasing the operating frequency. Using pin 5 in that way turns the 555 basic astable oscillator into a *voltage-controlled oscillator.*

Basic 555 VCO

A schematic diagram of a basic 555 voltage-controlled oscillator (VCO) is

PARTS LIST FOR THE BASIC 555 VCO (FIG. 2)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—10,000-ohm
R2—1000-ohm
R3—10,000-ohm potentiometer

CAPACITORS
C1—0.1-µF, ceramic-disc
C2—4.7-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
IC1—555 oscillator/timer, integrated circuit
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

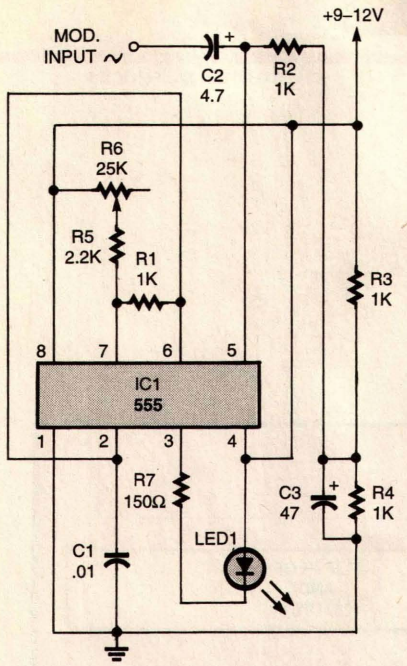

Fig. 3. By connecting pin 5 of the 555 to an external signal source, rather than the potentiometer used in Fig. 2, the signal output of the circuit can be frequency modulated.

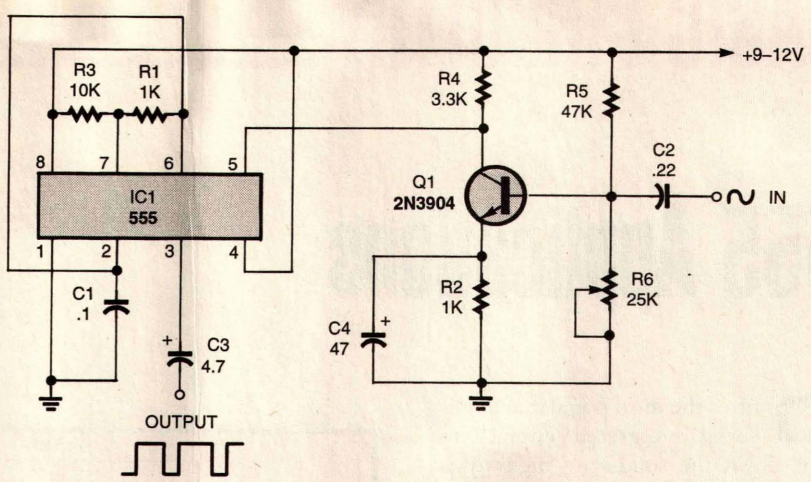

Fig. 4. The circuit in Fig. 3 can easily be modified, as shown here, allowing a very small external signal to modulate the 555's operating frequency. Instead of requiring several volts to modulate the oscillator, as is the case in the Fig. 3 circuit, only a few millivolts are necessary with this circuit.

PARTS LIST FOR THE FREQUENCY-MODULATED VCO (FIG. 3)

SEMICONDUCTORS
IC1—555 oscillator/timer, integrated circuit
LED1—Light-emitting diode, any color or size

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1-R4—1000-ohm
R5—2200-ohm
R6—25,000-ohm potentiometer
R7—150-ohm

CAPACITORS
C1—0.01-µF, ceramic-disc
C2—4.7-µF, 16-WVDC, electrolytic
C3—47-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

shown in Fig. 2. In that circuit configuration, pin 5 of IC1 is connected to the wiper of a 10,000-ohm potentiometer (R3), whose main leads are connected across the power source. Operating from a source voltage of 12 volts and with R3 set to its minimum voltage, the circuit oscillates at frequency above 6 kHz. At mid-voltage, the oscillator operates at a frequency of about 2.3 kHz, which drops to less than 400 Hz at 12 volts. That's a frequency range of about 6 kHz. Using different values for R1 and C1 changes the circuit's basic operating-frequency range.

Frequency-Modulated VCO

Our next VCO circuit, see Fig. 3, takes advantage of the 555's control-voltage terminal by allowing a varying signal to be applied to the 555 to frequency modulate (FM) its operating frequency. In our circuit, the oscillator's output is used to drive an IR LED. Such a configuration can be used for remote-control applications or voice transmission. The oscillator's center (unmodulated) operating frequency is set by R5, R6, and C1, while a voltage divider comprised of R3 and R4 establishes a bias at pin 5 of one-half of the supply voltage.

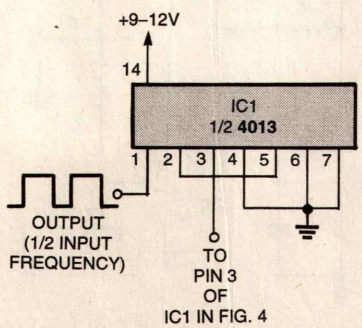

Fig. 5. This simple circuit, comprised of half of a 4013 CMOS dual D-type flip-flop, can be added to any 555 oscillator to produce a 50/50 symmetrical output signal. The flip-flop divides the applied signal frequency by two, producing a near perfect squarewave output.

With the component values given, the circuit oscillates at a frequency ranging from about 5 to 35 kHz. The circuit's frequency range can be altered by changing the values of R6 and C1.

The modulating signal should be no greater than about a quarter (25%) of the oscillator's operating frequency; the best linearity occurs when the voltage at pin 5 varies less than ±20%. The best modulation linearity can be found by experimenting with the voltage set at pin 5. That can be easily accomplished by either varying the value of R3 or R4, or by replacing both with a 2000-ohm potentiometer.

PARTS LIST FOR THE MODIFIED FMed VCO (FIG. 4)

SEMICONDUCTORS
IC1—555 oscillator/timer, integrated circuit
Q1—2N3904 general-purpose NPN silicon transistor

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R2—1000-ohm
R3—10,000-ohm
R4—3300-ohm
R5—47,000-ohm
R6—25,000-ohm potentiometer

CAPACITORS
C1—0.1-µF, ceramic-disc
C2—0.22-µF, ceramic-disc
C3—4.7-µF, 16-WVDC, electrolytic
C4—47-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

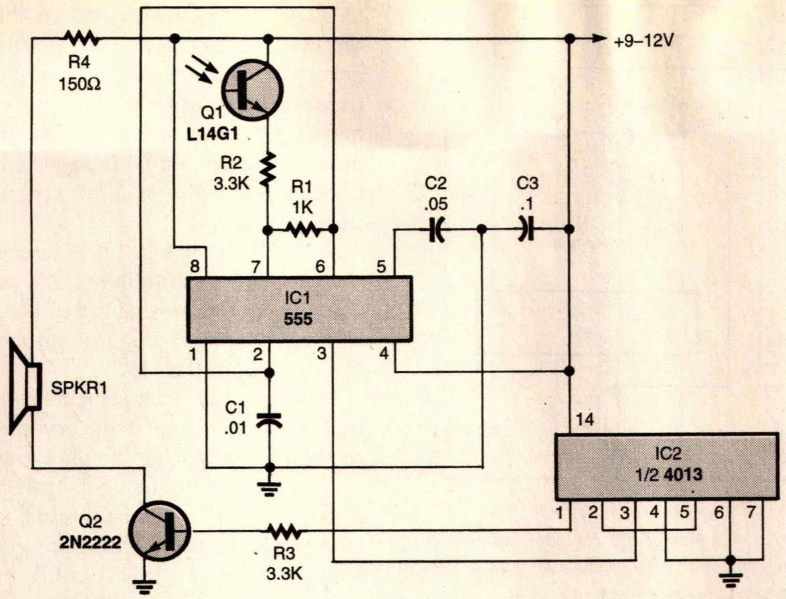

Fig. 6. The light-controlled oscillator doesn't rely on the control-voltage terminal (pin 5) of the 555 to vary the oscillator's frequency; instead the frequency-setting resistor has been replaced by a phototransistor (Q1), which varies in resistance and thereby frequency in accordance with varying light intensity.

PARTS LIST FOR THE LIGHT-CONTROLLED OSCILLATOR (FIG. 6)

SEMICONDUCTORS
IC1—555 oscillator/timer, integrated circuit
IC2—4013 CMOS dual D-type, flip-flop, integrated circuit
Q1—L14G1 (or similar) NPN phototransistor (Mouser)
Q2—2N2222 general-purpose NPN silicon transistor

RESISTORS
(All resistors are ¼-watt, 5% units.)
R1—1000-ohm
R2, R3—3300-ohm
R4—150-ohm

CAPACITORS
C1—0.01-µF, ceramic-disc
C2—0.05-µF, ceramic-disc
C3—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
SPKR1—Any small 8-ohm or greater speaker
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

Modified FMed VCO

Our next circuit, see Fig. 4, adds a transistor amplifier to the FMed VCO to produce a circuit that can be modulated by only a few millivolts, instead of requiring several volts—as is the case with the Basic VCO circuit. The Fig. 4 circuit also allows the voltage at pin 5 to be easily varied by manipulating adjusting the bias voltage applied (via potentiometer R6) to Q1. The oscillator's component values are the same as those used in Fig. 1; thus, it operates in the same frequency range. The frequency range can be modified by changing the values of C1 and R3. In addition, R3 can be replaced with a potentiometer to provide greater frequency adjustment. The 555 oscillator's output at pin 3 can be used to drive an IR LED, a small speaker, or another circuit.

The basic 555 oscillator does not produce a 50/50 symmetrical output; for some circuit applications that can be a problem. The circuit shown in Fig. 5 (comprised of half of a 4013 CMOS dual D-type flip-flop) can be added to the oscillator circuit to solve the symmetrical output problem. The output of the oscillator (in Fig. 4 for example) can be fed to the clock input (pin 3) of the flip-flop in Fig. 5. The flip-flop divides the applied signal frequency by two, producing a near perfect squarewave output at pin 1.

In order to establish the same output frequency as before, simply double the oscillator's operating frequency. That's easily accomplished by decreasing the values of the frequency determining components.

Light-Controlled Oscillator

Our next 555 circuit, see Fig. 6, doesn't use the control-voltage terminal (pin

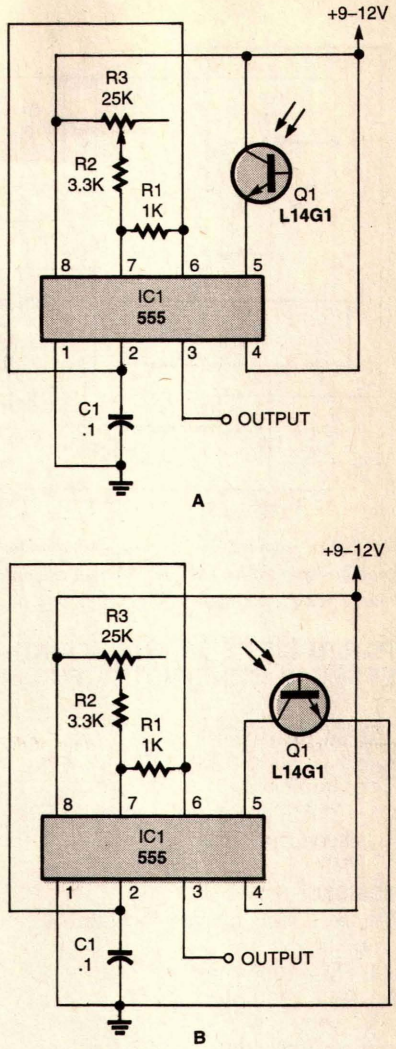

Fig. 7. Shown here are two light-controlled VCOs configured with only a slight difference. The circuit in A has the phototransistor connected between the CV terminal (pin 5) of IC1 and the positive supply rail, while the one in B has the phototransistor tied between the negative supply rail (ground) and pin 5.

PARTS LIST FOR THE LIGHT-CONTROLLED VCO (FIG. 7)

SEMICONDUCTORS
IC1—555 oscillator/timer, integrated circuit
Q1—L14G1 NPN phototransistor (Mouser)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1000-ohm
R2—3300-ohm
R3—25,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
C1—.1-µF, disc-ceramic capacitor
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

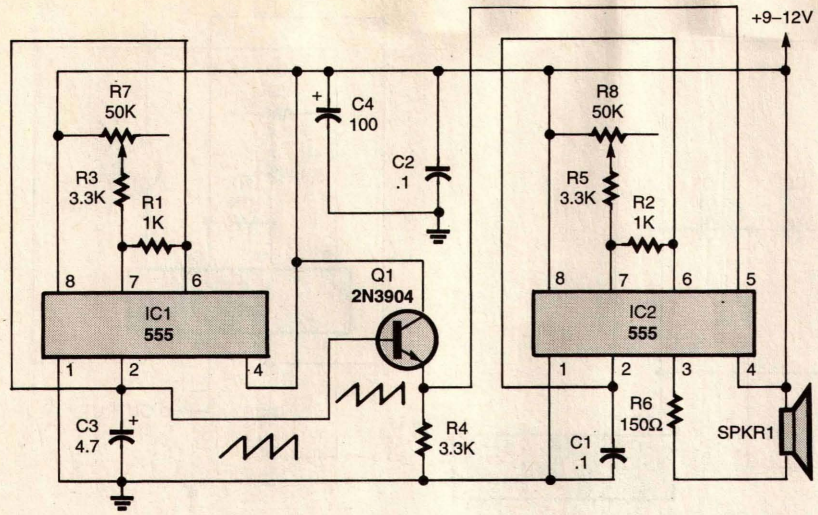

Fig. 8. The Sound-Effect Generator, comprised primarily of a pair of 555 oscillator/timers (which could be replaced by a single 556 dual oscillator/timer), can be used to produce all manner of neat sound effects, ranging from a chirping bird to a European ambulance siren.

PARTS LIST FOR THE SOUND-EFFECTS GENERATOR (FIG. 8)

SEMICONDUCTORS
IC1, IC2—555 oscillator/timer, integrated circuit
Q1—2N3904 general-purpose NPN silicon transistor

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R2—1000-ohm
R3-R5—3300-ohm
R6—150-ohm
R7, R8—50,000-ohm potentiometer

CAPACITORS
C1, C2—0.1-μF, ceramic-disc
C3—4.7-μF, 16-WVDC, electrolytic
C4—100-μF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
SPKR1—Small 8-ohm speaker
Printed-circuit or perfboard materials, hook-up wire, solder, hardware, *etc.*

5) of the 555 to vary the oscillator's frequency. (Note that in this application pin 5 is bypassed to ground through C2—a 0.05-μF capacitor.) In this application, the frequency-setting resistor has been replaced by a phototransistor (Q1), which varies in resistance with changing light. As the light increases, the oscillator's frequency goes up and as the light dims, the frequency goes down. Resistor R2 is used to limit the oscillator's maximum frequency when the phototransistor is at its minimum resistance.

The output of the oscillator is fed to the clock input (pin 3) of a 4013 dual D flip-flop (IC2), where the output of IC1 is divided by 2. The output of the flip-flop (at pin 1) is then fed to the base of Q2, where it is amplified and used to drive speaker SPKR1. The light-controlled oscillator can generate some unusual sounds when the phototransistor is positioned in an area where the light is constantly varying. That could be considered the light equivalent of a wind chime.

The frequency range of the circuit in Fig. 6 is very wide depending on the level of light hitting the phototransistor at any given time. An intense light source might send the frequency beyond the range of human hearing and little or no light can put the frequency into the basement. For a circuit that's designed to entertain, Fig. 6 is a good choice; but if the amount of light hitting the phototransistor is needed as data, the two circuits in Fig. 7 are a better choice. Let's move on to those now.

Light-Controlled VCO

In the Fig. 7A circuit, a phototransistor is connected between the CV terminal (pin 5) of the 555 and the positive supply rail. The oscillator's home or reference frequency is set by R3. An intense light source hitting the phototransistor lowers its internal resistance, thereby raising the voltage applied to pin 5. That makes the 555 oscillator take longer to complete its charging cycle, which lowers the output frequency. Placing the phototransistor in the dark raises the internal resistance to several megohms, which is like an open circuit to the CV input. Under that condition, the oscillator returns to its preset frequency. As the light striking the phototransistor increases, the oscillator's frequency begins to decrease. The maximum frequency shift occurs when the phototransistor goes into saturation (turns fully on).

The circuit in Fig. 7B is essentially the same as the circuit in Fig. 7A, except that the phototransistor is tied between the negative supply rail (ground) and the CV terminal of the 555.

That circuit arrangement reverses the direction of the frequency shift as the light level striking the phototransistor changes. A bright light hitting the phototransistor drives its internal resistance down, which, in turn, lowers the voltage applied to the IC1's CV input. That lowers the oscillator's trigger point, resulting in a higher output frequency—the opposite of what occurs in the Fig. 7A circuit.

Sound-Effects Generator

Our last circuit, comprised primarily of a pair of 555 oscillator/timers, can be used to generate all kinds of neat sound effects, ranging from a chirping bird to a European ambulance siren. A schematic diagram of the Sound-Effect Generator is shown in Fig. 8. In that circuit, IC1 is configured as a low-frequency variable-oscillator. Note that the output of the circuit is not taken from pin 3, as is normally the case. Instead the output of the oscillator (a sawtooth waveform) is taken from pin 2 and buffered by Q1. The second 555 (IC2) is connected in a similar oscillator circuit that covers the medium-to-high audio-frequency range. A small speaker is connected to the pin 3 output of IC2.

The buffered sawtooth output is fed to the CV terminal of IC2, which modulates its frequency at the low-frequency rate. An almost limitless number of sounds can be generated with the Fig. 8 circuit by playing with R7 and R8, and if that isn't enough, the values of C3 and C1 can be changed. If the sound output is too low, a coupling capacitor can be connected to pin 3 of IC2 and the signal fed to a power amplifier to increase the volume. But take my advice and live with the small speaker.

Well that's all the space allotted to us for this month, but be sure to join us next month for a look at another batch of useful circuits and the basic principles that make their operation possible. P

ProService Review

February, 2000

NESDA's 50th Year

An official journal of NESDA (National Electronics Service Dealers Association), and ISCET (International Society of Certified Electronics Technicians).

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PURPOSE

ProService Magazine, included in each issue of ***Poptronics,*** is produced by NESDA, the National Electronics Service Dealers Association, 2708 West Berry St., Fort Worth, TX 76109. It is intended for the enlightenment, education and entertainment of the members of NESDA, ISCET, and other ethical professionals engaged in or connected with the appliance, computer, and electronics service industries.

With the exception of official announcements, the statements and opinions expressed herein are those of the authors and not necessarily those of the associations.

Unless otherwise clearly indicated, neither NESDA nor ISCET endorses any company, product or service appearing in any article in this publication.

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NESDA.com: NESDA's Internet Home

NESDA continues the legacy of service to its members, including education, technical and management training, and discounted business services. The website introduces consumers, as well as servicers, to some *very* specialized information.

by Mary Margaret Merrill

The original, and primary purpose of NESDA.com is to bring useful information to NESDA's membership. To that end, the site has been very successful in the wealth of information presented. This includes links to other useful sites when NESDA doesn't have the final answer. NESDA's Internet Committee, and its Webmaster, work continuously to increase its usefulness to members. Have you visited NESDA's web site lately?

Non-members who are curious about NESDA are invited to visit the "What is NESDA?" section. Here, you can read about NESDA's mission to aid independent servicers in their business survival. Visitors are walked through a comprehensive explanation of NESDA's major benefits and programs. Additional information is available through the NESDA office.

BEYOND THE ORDINARY

Special sections are devoted to two of the better programs. One of these is NESDAnet, the servicers' e-mail network. This includes participating NESDA members, NESDA officers, manufacturers, and parts distributors. Also featured is NWSN, the NESDA World Service Network. NWSN is a marketing initiative for qualifying businesses utilizing the Internet as a marketing tool. Both programs are optional at an extra cost so that non-participating companies do not have to pay for programs they do not support. Most questions about either program are answered in the FAQs (Frequently Asked Questions) of each section.

CERTIFICATION

For those who are interested in certification programs, the web site lists three (four, if you count the NWSN) such programs. They include a technical certification program available for technicians and a managerial certification available for Service Managers. The P.R.I.D.E. Program, which certifies NESDA member businesses, requires those businesses to have certain types of equipment, assures that they can handle specific repairs, and lists companies that they are authorized to do warranty service for.

EDUCATIONAL OPPORTUNITIES

NESDA actively promotes education of its members to help them keep up with the rapidly changing technology. Due to the relative complexity of today's electronic products, very often a technician will require specialized training in order to effect repairs, or even just to troubleshoot a broken consumer product. The NESDA web site offers several options for onlookers.

Additionally, everyone in product servicing is invited to attend the annual National Professional Service Convention. Here, major manufacturers offer technical seminars on the repair of their high-technology products. These companies include Hitachi, Philips, Sony, and Toshiba, just to name a few. Anyone interested in more information about pending convention dates and topics may find it on the web site.

At NPSC, managers are also offered seminars on how to improve their busi-

(continued on PS-2)

(NESDA.com, continued)

nesses. On the web site, some of the most popular seminars of the last few years (Best Ideas Contest) are posted for viewers. Ideas include many innovative, cost-effective, money-saving techniques that can be employed by members and non-members alike to make their business more efficient.

PUBLICATIONS

Several publications are available to NESDA members, including this magazine, the *ProService Directory & Yearbook,* and several newletters. The annual 128-page *Directory* lists almost 1500 manufacturers, parts distributors, educational sources, software providers, trade associations, trade publications, and more. The web site offers articles from back issues, as well as subscription information.

MEMBERS ONLY

All of the previous information pales by comparison once you reach the "Members Only" section. Access is limited, by password and code, to current members of the association.

NESDA members can access several manufacturers' warranty terms online, for viewing or downloading, by entering a manufacturer and a product's model number. There is also an online Cost of Doing Business calculator, a downloadable (free) technical tips program, and training information from the last National Professional Service Convention. And, if that's not enough, members can offer suggestions to improve the web site, or the association.

However, of primary interest to members may be the Extended Warranty Payment Performance Report. In the report, third party warranty administrators are rated by participating companies according to their payment of claims. By monitoring the report regularly, servicers can spot slow- or non-payment trends in order to limit liabilities with possibly failing warranty companies. Another similar report, monitors Manufacturers' Payment Performance. Both are invaluable tools to members when used judiciously.

EVEN CONSUMERS BENEFIT

Although NESDA.com was originally slanted toward the servicer, a consumer section was later added. Answers to FAQs regarding the mystery of extended warranties are available. Consumers are further informed of the advantage of using a NESDA member servicer to assure quality repair at a fair price. In addition to a display of NESDA's Code of Ethics, consumers may search for a NESDA member servicer by zip code to find the closest one to their area. This advertising may be of primary importance in the future as NESDA prepares for a new marketing effort geared toward consumers. It is hoped that the increased awareness of NESDA and its member servicers will enhance not only current members' businesses, but also add to membership rolls as well.

The site also offers consumers advice on "Getting Good Service." It attempts to answer any questions consumers may have about choosing a service center, how to save money by carrying in the unit themselves, and legal recourse if their complaints are not addressed.

WORKING TO SERVE YOU

There's a wealth of information available at your fingertips. To see the difference that information can make in *your* business, visit www.nesda.com. Get on the NESDA wagon and put some highly specialized information to work for you. §

NESDA Corporate Members

B & D Enterprises
Computer Parts Unlimited, Inc.
CQ Communications (ES&T)
Diversified Parts
Electro Dynamics, Inc.
Electronic Software Developers
Gernsback Publications
Hitachi Home Electronics (America) Inc.
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Nintendo of America Inc.
Pacific Coast Parts
Peg Perego USA, Inc.
Philips Consumer Electronics
Pioneer Electronics Service Inc.
PTS Electronics Corp., Inc. ***(LIFE Member)***
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Tandy Retail Services
Toshiba America
VAC Service Corp.
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Gernsback Publications
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My Corner of the Web
by Sheila Fredrickson, NESDA/ISCET Webmaster

Now that we're here ... what next?

Early in January of 1999 the NESDA Board of Directors voted to move the responsibility for the NESDA website, ***NESDA.com,*** in-house. The objective was to have the website updated and maintained by staff. This decision allowed the site to be maintained and modified in a much more reasonable length of time than it was previously.

The next phase has involved building the current site into a first-class resource for NESDA members. Early on, the website provided tech tips and manufacturer information. At that time, most manufacturers did not have sites of their own from which to provide up-to-date information. However, during the last couple of years this has changed. Now there are few, if any, manufacturers that do *not* have sites for service information.

A meeting at the 1999 National Professional Service Convention helped generate a great idea from the folks at Thomson. A plan was formulated to build a page for *each* manufacturer in the "Members Only" section, so that the manufacturers themselves could provide up-to-date information for servicers. In view of this, NESDA.com has begun to replace current service information with links to manufacturers' sites. A number of other manufacturers have indicated they wish to participate. To this end, a volunteer from one of the manufacturers has committed himself to helping us put these pages together, though it is not certain when they will be available.

The Association wishes to thank you for your support as NESDA continues to build improvements for members. It is sincerely hoped that this will make it easier for you to have a profitable business.

Representing and Fighting for Independent Service

You Are Not ALONE!

NESDA is the national association dedicated to the plight and security of the independent service dealer — whether you service appliances, computers, consumer electronics, industrial electronics, MATV, biomedical instrumentation, TVRO, etc.

NESDA engages in fruitful dialogue and mutual cooperation with manufacturers who recognize and respect independents' rights. However, NESDA is also ready to fight unfriendly manufacturers and other monopolists in the halls of Congress or the chambers of the U.S. Supreme Court.

When You Join NESDA, You Get:

- Prestigious member identification material for door, wall and wallet
- Free subscription to every issue of *Poptronics,* which includes *ProService,* "news you can use" about the product service industry
- Free copy of the *"ProService Directory,"* 128-pages of service industry contacts
- Free members-only newsletters: "NESDA Newsletter," "Legislative Alert," special bulletins, and more
- Access to manufacturers' key service executives through NESDA's effective industry relations committee
- Access to headquarters staff for personalized advice or referral to authoritative source or knowledgeable members
- Access to the minds of other dealers — and other business experts — willing to share information freely
- Purchasing discounts for members on a variety of business aids, invoice forms, merchandise, and more
- Access to an annual convention and trade show with the industry's best and most cost-effective professional training
- National-level representation to government, manufacturers, etc., on important business and industry issues
- Much, much more *(for a full description of benefits and programs, return coupon)*

When You Join NESDA, You Get Help!

Isn't it time you joined the other professionals in electronics?

❑ *I want to find out more. Send information about NESDA, including an application.*

Name _____

Business _____

Address _____

City _____

State _____ Zip _____

Mail to NESDA, 2708 W. Berry St., Fort Worth TX 76109; 817-921-9061 or Fax to: 817.921.3741

— Management —

The Scoop on Internet Hoaxes

Any number of dire warnings come to us via e-mail. Some sound obviously far-fetched, yet others are very believable. Which are real?

by Richard Ensman

"Warning: If you receive an e-mail message titled 'Urgent News,' do not open it! This powerful e-mail message will reformat your hard drive and create an undetectable code that will, in turn, literally 'bake' your computer system and, perhaps, even send the room up in flames. The Federal Computer Virus Response Authority (FCVRA) has documented thirteen instances of serious injury as the result of this virus."

Before you start shaking with fear, you should know that this simple message is but a fabrication. "Urgent News" is not a real virus (at least not yet), and viruses can't "bake" your computer system or send your home or office up in flames. And there's no such bureaucratic creature as the Federal Computer Virus Response Authority. This "warning" is simply an example of the kind of hoaxes proliferating on the internet today. Many of these hoaxes would be laughable if it weren't for the fact that so many tens of thousands of people were taking them quite seriously — so seriously that computer programmers, official agencies and technical support lines are swamped with calls from worried computer users.

Viruses do exist, of course, and computer users should take serious precautions against them. But let's digress to the silly side of the internet for a few moments and examine a few of the common hoaxes on line today.

Want to have a good time? The "good times" hoax begins like many of the supposed e-mail viruses: it informs readers that if they see the term "good times" in the header of an e-mail message, they should delete it immediately. The supposed consequences of reading such a message can include infected files and reformatted hard drives. Often the warning purports to be based on a Federal Communications Commission announcement. Like most warnings, this is bogus.

Time to clean up. This hoax message makes the rounds every few months. The hoax comes in the form of e-mail messages claiming that some official-sounding internet authority, the United States government, or the United Nations, is planning to do "required maintenance" on the internet, and will shut it down for a few hours or a day. Usually a specific day is mentioned and computer users are instructed to disconnect their machines from all power sources at that time in order to prevent serious damage to their computers. A recent variation of these hoaxes comes from computer tricksters who claim that they are about to cause havoc on the internet, and are quick to warn users to stay off the electronic highway for a day or many days at a time to avoid computer damage.

Care for a pen pal? This supposed e-mail virus begins with the header "Pen-pal" greetings. The warning message, which has appeared tens of thousands of times recently, suggests that infernal things are going to happen to thousands of computers across the globe once readers happen upon the text of the message. The message claims not only to damage the user's hard drive, but to replicate itself in the form of additional e-mail messages to everyone in the user's e-mail directory which, when opened, will cause damage to still more computers. (This hoax message should not be confused with the recent "Melissa" virus — a real one — which was broadcast via e-mail attachments). The "death ray" warning message, however, sounds much more serious. This message announces a virus that supposedly causes computers to explode. It may even "document" the names of people who have died from explosions and the hoax message may be filled with legitimate-sounding technical jargon.

Keypunch for dollars. These hoaxes often begin with the title "free money," "great business opportunity," or the electronic equivalent of some other "get rich quick" scheme. Some simply offer bizarre instructions to send a particular e-mail

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(Hoaxes, continued)

message to ten, twenty, or thirty people, after which time dollars will come gushing into the sender's mailbox. Others request computer users to send money for a secret instruction manual.

Beware the Aids virus. The warning message for this hoax alerts computer users to avoid messages beginning with the words "open," "cool" or some other simple phrase. Once opened, the virus supposedly eats away system memory and the hard drive, little by little, eventually rendering the system useless.

Send this ... or else. The cyberspace equivalent of the old-fashioned chain letter has arrived. Although these electronic chain letters have many variations, they usually instruct the computer user to send a particular e-mail message to five or ten people with instructions to send it even further. Failure to send the message, the hoaxes claim, may cause some personal calamity or the destruction of the computer's hard drive. And yes, serious and intelligent computer users occasionally believe these messages.

Watch out for freebies. These hoaxes, popular recently, purport that well-known computer companies are giving away free merchandise or services in return for some obscure help on the part of computer users. One hoax, for instance, claims that Microsoft Corporation will give away free computers to a certain number of people who transmit a specified message to other computer users. Still another common hoax involves free Disney World passes which will supposedly be sent to people who send e-mail messages to a number of their acquaintances.

Stay alert for danger signs. The internet is always filled with hoaxes about supposed calamities that will occur at some point in the future. The FCC, claims one hoax, is about to impose per-minute charges on all internet service providers for computer access time. Whether charges like these might ever come to pass in North America is open to speculation, but the hoax claim is false. Still other hoaxes revolve around the so-called millennium bug and bizarre millennium tests that computer authorities or businesses will run, causing "serious damage" to computer systems across the world.

Beware of those household poisons. These seemingly helpful consumer warnings appear on the internet with all manner of new "findings" about common household and personal care products. They alert consumers to the supposed snake venom in various fruit juices, the cancer causing properties of various shampoos, and the bacteria present in cleaning products. Consumer product manufacturers receive calls from worried consumers who receive these messages.

Watch your money. These hoaxes purport to document huge financial losses that befall unsuspecting consumers. Perhaps the best known hoax involves a major department store that supposedly quoted the price of its recipe for a chocolate chip cookie as "two fifty" — and then charged the willing buyer's credit card not for $2.50, but for $250.00. This message even lists the names of people who have been supposedly victimized. But it never happened.

Pull the heart strings. These heart-throbbing messages ask recipients to send e-mail messages, post cards or even money to some terminally ill child living in an obscure part of the world. Sometimes the message claims that the child expressed a dying wish to be listed in a book of records as receiving a huge number of messages. Other times the messages claim that some national charity will donate funds to heart or cancer research for every e-mail message received. C'mon folks.

Call your legislator now. Then there are the hoaxes that describe pending leg-

(continued on PS-5)

Where can you go to ...

- Hear industry news as it happens
- Request advice on specific needs from other servicers
- Locate hard-to-find parts
- Solve problems together
- Expose unfair business practices
- Receive NESDA and association news
- Help formulate industry standards
- Share unpublished warranty policies
- Participate in roundtable discussions

Be a Part of NESDAnet

the Professional Servicers' E-Mail Network

What is it?

NESDAnet is a group of astute professionals working together to improve their service businesses.

How does it work?

Electronic messages (e-mail) are sent via the Internet to the NESDAnet computer. The NESDAnet computer system then forwards the message to other users.

Who can join?

Any independent servicer who is also a member of NESDA is welcome. The current membership also includes NESDA headquarters, NESDA board of directors, manufacturers, field service reps, service contract companies, warranty claims processors, parts suppliers, national trade organizations, and association editors.

With NESDAnet, *you are never "the only one."*

What is needed to participate?

Membership in NESDA, a computer, a modem, and a subscription to any Email account.

What is the cost?

$60 per year *(does not include NESDA membership, Email subscription, or phone-line charges.)*

If you're not a NESDA member, you should be.

For more information, go online to www.nesda.com, or write to:

NESDA

2708 W. Berry St., Ft. Worth, TX 76109 • 817-921-9061 • Fax 817.921.3741

(continued from PS-4)

islation requiring immediate citizen action. These e-mail messages describe legislation that will outlaw e-mail, abolish the voting rights act, eliminate religious freedom, or do some other nefarious deed. Often, an authentic "bill number" or legislative sponsor name appears in the message. And yes, legislators receive calls about these fictitious pieces of legislation.

Urban legends invade the internet. These widely-believed, but fictitious stories, have now made their appearance on the internet. They include stories of shoppers who have been injured at malls by thieves hiding under their cars and stabbing their ankles with sharp knives ... hotel guests who have been robbed of their kidneys ... and stories of wild abductions of children.

The bottom line: the internet is full of hoaxes today. When you receive an e-mail message or happen upon a Web site that makes a seemingly outrageous claim, maintain a healthy skepticism about it. There's a chance it may be little more than the product of a fictitious imagination, so check it out before you turn your worry button on.

HOW TO DETECT A HOAX

While you may not be able to identify a hoax with 100% certainty, these common sense guidelines will give you clues about the truth or falsity of a particular claim:

- If it sounds too good to be true, it probably is.
- If it sounds to be bad to be true, it probably isn't.
- If it comes from a dubious source, question the message.
- If it confuses you, remember that the confusion may be deliberate. Show the message to a knowledgeable computer professional.
- If it makes vague references to evidence or to well-known companies or computer authorities, check the hoax out with them.

IF YOU SUSPECT IT'S REAL

- Don't panic. The percentage of hoaxes that actually end up harming passive computer users is small.
- Don't open attachments from unfamiliar sources. They may contain code that can, indeed, affect your system.
- Install anti-virus software and keep it up to date. This software will help keep your computer safe from the real viruses out there. Several sources are:

Symantec/Norton Anti-Virus Research Center: http://www.symantec.com/avcenter/

Macafee Software: http://www.macafee.com

Trend Micro's PC-cillin: http://www.antivirus.com/pc-cillin/

Dr. Solomon's "Virus Central": http://www.drsolomon.com/vircen/index.cfm

Central Command's AntiViral Toolkit Pro: http://www.avp.com

Research hoaxes by checking with competent authorities and online sites that debunk hoaxes. Try these ...

Energy Department's Computer Incident Advisory: http://ciac.llnl.gov/ciac/CIACHoaxes.html

Computer Virus Myths Page: http://www.kumite.com/myths

Urban Legends Page: http://urbanlegends.miningco.com/library/blbyolix.htm

Don't send e-mail messages about hoaxes to other people unless they are verified by a credible source.

Laugh and enjoy them. And remember: most are simply the product of overactive imaginations. §

— Professional Servicers —

Surviving the Downward Spiral

Technologies are combining to eliminate the service industry as you know it. It's not a conspiracy; it's progress. There are things you can do to survive — even prosper — if you take action now.

by Paul Gendreau

Soon the era of the one-chip TV will be upon us. Troubleshooting via the Internet, high-density manufacturing techniques, and solid-state displays are right around the corner. The technology for a one-module TV, combined with inexpensive solid-state displays, will make TVs — even big screens — as cheap as yesteryear's VCR.

Solid-state displays will mean no picture tubes, high voltage transformers, or high-power deflection components. If you're relying on poor solder connections and other reliability issues for a chunk of future business, think again.

THE BAD NEWS FIRST

With the elimination of high voltage and sweep components, power dissipation will tank and product reliability will soar. This will cause retail prices to plummet even further, especially as manufacturers squeeze the cost of service out of the equation. Already, the manufacturing cost of consumer electronics is but a tiny fraction of what you'll need to feed your family. Manufacturers and consumers will figure out that service is a needless layer of cost between the two, outweighing any added value.

Replacing a few products via retailers for actual failure (fuses, lightning hits, honest to goodness failures in general) will hardly impact a manufacturer's balance sheet when compared to paying service centers for warranty repairs. In the future, say goodbye to warranty service.

As consumers become accustomed to the new paradigm (it's not *that* new, it's here already) of throwing electronic gadgets away and buying new ones, they will not seek service. So you can plan on saying goodbye to out-of-warranty service, too.

RIDING OUT THE STORM

The above conclusions may not be universally shared, and certainly aren't popular. But it's probably more realistic than you dare to admit. Some of you at least *suspect* it to be true, and the bravest among you are already planning for it. What can you do to ride out the storm?

Well, you can try to eke out a living by working harder, doing more tomorrow of exactly what you do today. However, short-term strategies — or no strategies at all — seldom yield more than short-term success. You should be planning more than one year ahead. If not, then by default you're planning to retire in the next few years. Here are a few thoughts to get you started.

(continued on PS-6)

(Surviving, continued)

KNOW YOUR BUSINESS COSTS

Know your cost of doing business! It may seem silly to have to say this, but it's a primary cause of death for servicers. Analyze your costs to death. Use pencil and paper if you can't figure out how to use a spreadsheet. But don't dare *not* to do it. It's time to squeeze out all costs that don't add value to the services you deliver. Ask those questions from your customer's perspective. In fact, ask your customers. Abandon those parts of your business that are not profitable.

Break out of the pack and learn how to obtain repair parts at a lower cost. Traditional distributor and dealer chains have broken down in recent years, especially with the advent of the Web. It's possible for you to purchase parts at distributor-level prices with surprisingly low volume requirements. It's important to shop around if it doesn't compromise quality.

AUTOMATE YOUR BUSINESS

With PCs priced at under $500, there's no valid reason to put off using this powerful business tool. You'll need it to provide even entry-level customer service. Service management software will let you answer your customer's questions quickly, track productivity, and take the hassle out of repair parts ordering. Moreover, a PC is essential to maintaining the level of productivity that you'll need to stay alive. For example, using any of a variety of technical tip software can play an important role in maintaining profitability. Increased productivity can easily offset the price of a computer and software.

Your PC will also figure into your ability to diversify into other business opportunities. If you think that you're in the repair business, think again. You're in the information business. Your ability to gather and process information will determine your ability to move forward.

LEVERAGE THE KNOWLEDGE OF YOUR PEERS

Not enough servicers are using computers, and even fewer are on-line. In fact, a staggering number of even association members are not on line. Networking with other service centers through Internet email groups can be critical to your survival and your awareness of what opportunities are available to you.

Frankly, if you're not on-line yet, this should be your number-one priority. There's no single better tool for generating new ideas for your business. And there's no better tool for helping you solve technical problems. You don't have to brainstorm alone anymore, nor do you have to fight those dogs alone.

HAVE AN EXIT STRATEGY

Very few individuals create a business that survives beyond them. In that sense, they never build a business, but only create a job for themselves and a few employees. Your business is a long-term investment and you should have an exit strategy.

When it comes time to cash in on your investment, there's nothing to sell if your business model hinges on you being part of the business. You'll need more to offer than a few tools, a name, and customer goodwill. Foster a business model that replaces you as soon as possible. If your business can operate beyond you and without you, then you'll have a salable enterprise.

EDUCATION OPENS NEW DOORS

Be proactive in learning about emerging technologies, and think about how you can use them to your advantage, either as business opportunities or as part of your business practices. Take advantage of every opportunity for training. Determine how you'll be able to diversify your skills, or how you can use your current skills to build other income streams into your business.

The consumer-electronics service industry is in decline; the debate is only about where it will stop. While this assessment may seem like gloom and doom, there are reasons for optimism. The skills you have — as a technician and as a businessperson — will always be in demand and will generate income for you. However, now more than ever, you must take action to ensure that. Don't bet the bank that what you're doing today will buy groceries five years from now.

Do what you know how to do; do it as cost-effectively as you can; be prepared to diversify or move on in the next few years. Above all, have a plan. Whether you agree with this analysis or not, preparing for it as one possible outcome is a smart thing to do. It is foolhardy not to plan and analyze.

About the author: *Paul Gendreau is a partner of KDTV Software, the publisher of WinSTIPS technical tips software. You may contact him at: KDTV Software, or Paul Gendreau, P.O. Box 349, Sanford, ME 04073, Tel. (207) 490-1835; Fax (207)490-1893; email Paul@Service Software.com* §

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— Management —

Driving Forces of Change for the New Millennium

Customers are becoming more vocal, demanding more value for the dollars they spend. Efficiency, coupled with quality, is what it takes to satisfy them. Are you willing to make the changes necessary to keep up with the times?

by Robert B. Tucker

As we approach the new millennium, the businesses that succeed are the ones using innovative ways to create value for their customers. To beat their competition and gain an edge, here are some ideas driving innovative businesses operations.

Real Time Responsiveness: Winning businesses will eliminate customer waiting, whether in line, on hold, or over time. For instance, financial institutions will be forced to give instant mortgage loan approvals. And retailers will need to find ways to eliminate waiting in line because of increased competition from electronic commerce. How can you reduce the amount of time spent during a customer's transaction? What changes can be made to facilitate "speed" satisfaction?

User-Friendliness: The trading stamp industry disappeared because it was too inconvenient. In the next five years, the "cents-off" coupon will also disappear. Consider reexamining your "convenience quotient" in light of changing, more harried lifestyles. Examples include the trend toward 24-hour stock trading, real estate firms previewing homes on the Internet and home delivery of groceries for busy consumers. Rethink your entire operation to make what you offer more accessible, user-friendly, and portable. Think "one-stop shopping" and reduce the hassle. Make doing business with you easy.

Aging Boomers/Generation X: Generation-X and the Turning-50 Boomers present countless opportunities for creative responses. On the horizon is a growing Generation-X labor shortage. Imagine a motel designed so that the night clerk, instead of snoozing, launders sheets and towels in a high-tech washer/dryer installed behind the desk. Rooms are designed to take less time to clean. Guests can use their own credit cards to access their rooms. Sound farfetched? It's the way Sleep Inns are built today to counter the growing Baby Bust labor shortage. Brainstorm ways to reduce and make better use of labor so you can more efficiently provide the services your customers demand.

Mass Customization: Increasingly sophisticated consumers demand more options and "have it your way" solutions in both products and services. Levi Strauss stores measure hard-to-fit women and use the computer to send the specs to their plant in Tennessee. The customer receives the jeans just a few days later. Future-focused leaders will anticipate what it is about their services or products that could benefit from mass customization and respond accordingly. Innovations come from listening to customers' needs.

Lifestyle: Changing lifestyles are affecting every business. For example, the health and fitness trends are over, fat is back. Families pulled in all directions by busy schedules fly away on vacations away from phones and distractions. Thirteen million Americans are self-employed and work from home. How are changing lifestyles affecting what your customers want from you? How can you profit by responding to these changes?

Unbundled Service: Look for price cutting to intensify even further, spreading to unlikely arenas such as professional services. For example, by teaching do-it-yourself homeowners how to fix up homes, Home Depot saves them money. What services can you eliminate from your lineup in order to give the customer a lower price and still make money?

Value Differentiation: If you're not going to be the low-price leader, you must add value continuously. Four Seasons Hotels have computer banks that store information about each guest. Customer Smith prefers a non-allergenic pillow; customer Jones likes a rare kind of tea. The customer wants to know, "What have you done for me lately?" Make sure the value you add to your services is the value your customer seeks.

High Service: Excellent customer service for beleaguered American consumers is so rare that people pay extra for it. In response, Mobil decided to go "high service" and wash windshield sand and provide clean rest rooms for motorists with its "Friendly Serve" campaign. So far, it's working. The real differentiation is assembling a team that really cares. This is the real frontier where smart leaders will devote creative energy.

Techno-edge: Technology is not advancing, it is exploding. The future belongs to executives who embrace its possibilities and become early adopters, rather than becoming Techno-Roadkill. Search for new tools and software that increase speed, add convenience, raise productivity, and, most of all, challenge conventional wisdom about what can and cannot be done in your industry. Look for techno-edges that can borrowed from other industries.

Quality Perfection: The "quality revolution" is over, but quality as perceived by the customer is anything but guaranteed. now, the expectation of quality is so high that unless you have an empowered workforce and spirit of partnership with all stake holders, you can't compete. This can quickly build a competitive advantage because there's so little of it. Defects add aggravation to today's harried consumers. Businesses from Rolex to H&R Block have profited from designing quality into operations and exploiting it in marketing. Where do your customers perceive a lack of quality? Are you unsure of where to start making improvements? Ask your customers what they think about your quality.

The new millennium promises to be anything but "business as usual." Company leaders need to proactively *change with* change, rather than *react to* change. Innovation — coming up with ideas and bringing them to life — must take place at every level of the organization. Resting on one's laurels is no longer going to be an option.

About the author: *Robert B. Tucker is a keynote speaker and author of* Managing the Future: 10 Driving Forces of Change for the Next Century *(Berkley Books). Details: (800) 239-6681. E-mail: InnovationResource@compuserve.com* §

SERVICE CLINIC

(continued from page 38)

the capstan during play, record, and search modes. It is constructed as a molded rubber sleeve fused to a metal roller on a small ball bearing.

Audio/Control Head Stack—This is found between the right roller guide (when tape is loaded around drum) and the capstan. It includes the magnetic heads for non-Hi-Fi (linear) audio and the synchronization control track.

Back-Tension Arm—Located on the left side just as the tape exits the cassette, this is coupled to a felt *Back-Tension Band* and serves to maintain a constant tension on the tape during play, record, and forward search. It retracts toward the cassette when the tape is unloaded.

Various other *Fixed-Guide Posts*—A series of vertical, stationary metal posts that guide the tape. The positions of these vary somewhat by manufacturer.

Full-Erase Head—This is found on the left side towards the rear. The tape passes over it just before going around the roller guide, guide post, and drum. It rarely causes problems.

Impedance Roller—A freely-rotating roller that stabilizes tape movement. Some VCRs lack this component. If it is included, it is found on the left side near full erase head.

Half-Loading Arm—Located near the capstan/pinch roller on the right side. On VCRs with "rapid" or "instant-access" transports, this helps to position the tape in the intermediate (half-loaded) position. A similar arm is usually present in other VCRs and helps to position the tape around the pinch roller.

Belts—They come in various sizes and look like black rubber bands. The quantity of belts depends on the manufacturer; a typical VCR will have between 0 and 12 of them on top and bottom. Typically, you'll find three or four. Most belts are square in cross-section, though an occasional belt might be flat or round. The belts usually need replacement after a few years.

That's it for now. Until next time, check out my Web site, *www.repairfaq.org*. I welcome comments (via e-mail only, please) of all types and will reply promptly to requests for information. See you next time! P

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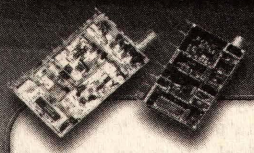

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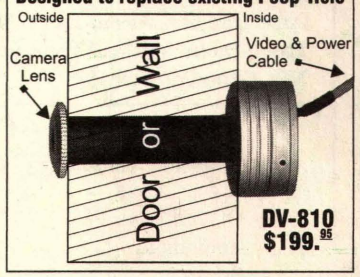

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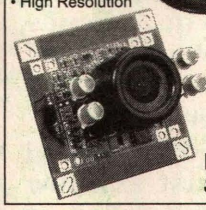

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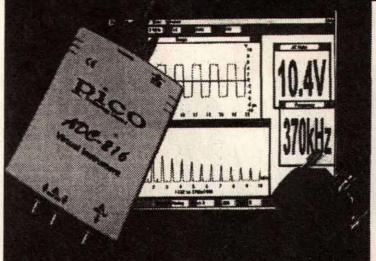

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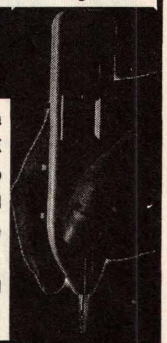

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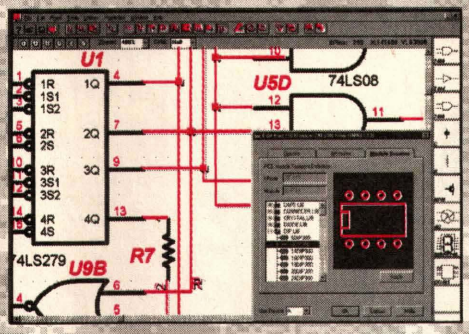

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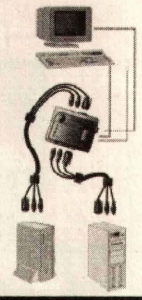

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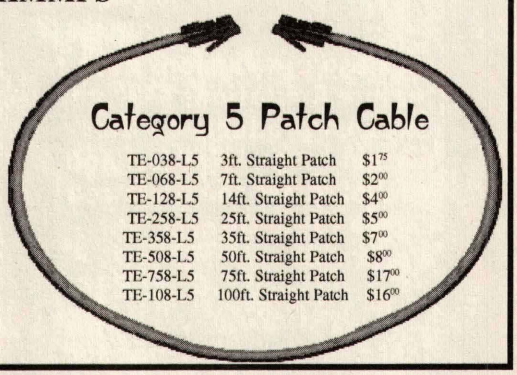

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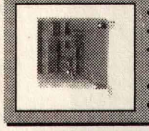

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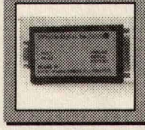

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- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

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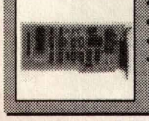
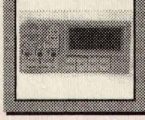


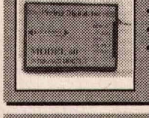
- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 . . . . $179



- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 . . . . . $109



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 . . . . . $239

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- 18 BIT A/D
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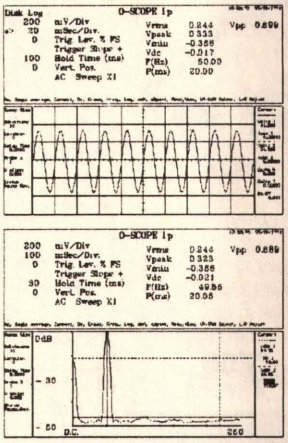

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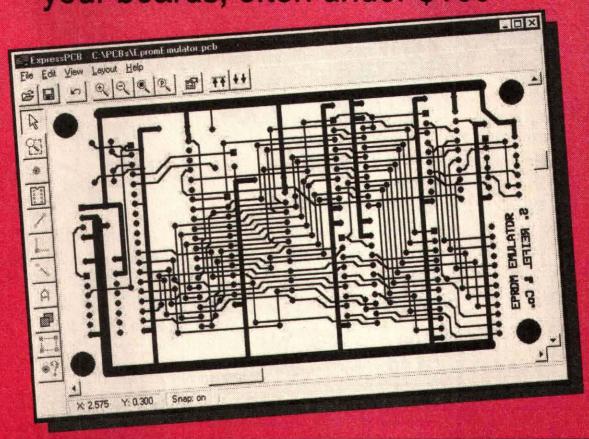

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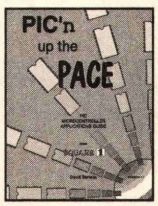

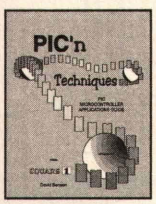

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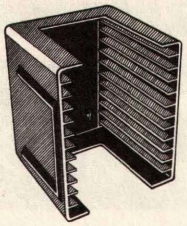

Organize your CDs or CD ROMs with these high-impact, black plastic CD storage racks. Slots for 12 jewel cases. Each 12 CD module can interlock vertically and horizontally with other modules. Can be free-standing or wall mounted.

CAT# CDR-3

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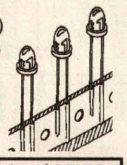
3000 MCD ULTRA-BRIGHT RED LED



Everlight # 383URC-2/TR1-C(R) Red, "Ultra-bright" T 1 3/4 LEDs "Tape-and-reel" parts. These are 5 mm diameter water-clear LEDs that light bright red at 20 mA. **CAT# LED-50**

2 for $1.00

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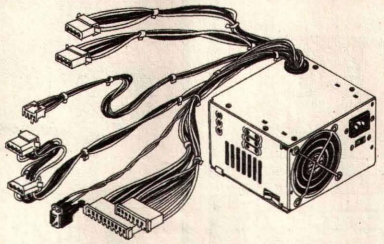
1000 for $250.00

REDUCED PRICE! 185 Watt Power Supply



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Input: 120/ 240 Vac (switchable)
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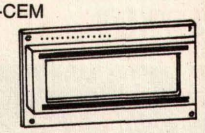

Optrex # DMC 20434-CEM (PWB 20434-CEM)
5 x 8 dot format.
3" x 1" viewing area.
3.88" x 2.38" module.
Removed from new equipment. May have felt padding on metal bezel. 14 pin single row header is pre-attached Spec/hook-up sheet included.

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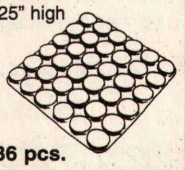

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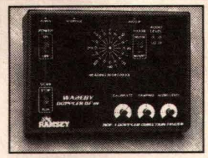
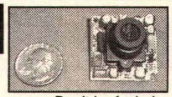


Doppler Direction Finder

Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF'er featured in April 99 QST. Shows direct bearing to transmitter on compass style LED display, easy to hook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of $1000.00! This is a neat kit!!

DDF-1, Doppler Direction Finder Kit $149.95

CCD Video Cameras



Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

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CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....$69.95
CCDCC-1, Color CCD Camera, wide-angle lens $129.95
IR-1, IR Illuminator Kit for B&W cameras $24.95
IB-1, Interface Board Kit.....$14.95

Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit $249.95
FM-100WT, Fully Wired High Power FM-100.....$399.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add our matching case and whip antenna set for nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit.....$34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter.....$9.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit.....$24.95
FR-6, 6 Meter FM Ham Band Kit $34.95
FR-10, 10 Meter FM Ham Band Kit.....$34.95
FR-146, 2 Meter FM Ham Band Kit.....$34.95
FR-220, 220 MHz FM Ham Band Kit.....$34.95
SR-1, Shortwave 4-11 MHz Band Kit.....$29.95
Matching Case Set (specify for which kit).....$14.95

Tiny Transmitters

Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM4,5 operate in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part!

FM-4MC, High Power FM Transmitter Kit $17.95
FM-5, World's Smallest FM Transmitter Kit.....$19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit ...$39.95
FM-6, Fully Wired & Tested 2M FM Transmitter $69.95

FM Station Antennas

For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

TM-100, FM Antenna Kit $39.95
FMA-200, Vertical Antenna $114.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case.....$99.95

AM Radio Transmitter

Operates in standard AM broadcast band. Pro version, AM-25, is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 is tunable, runs FCC maximum 100 mw, range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set that dresses up the unit. Great sound, easy to build - you can be on the air in an evening!

AM-25, Professional AM Transmitter Kit $129.95
AM-1, Entry level AM Radio Transmitter Kit.....$29.95
CAM, Matching Case Set for AM-1.....$14.95

Dinky Radios

Everyone who sees one of these babies says they just gotta have one! Super cute, tiny (that's a Quarter in the picture!) FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. The crystal clear sound will amaze you! Makes a great gift.

MFMT-1, World's Smallest FM Radio.....$11.95
PFMR-1, Pager Style LCD Clock & FM Radio $12.95

Touch-Tone Reader

Read touch-tone numbers from any radio, phone line, tape recorder - any audio source! Decipher called numbers on scanners, radio shows, anywhere touch-tones are used. Memory stores up to 256 digits, an 8 digit display window scrolls anywhere in memory. Memory good for 100 years, even with power off! Runs on 7 to 15 volt DC, Available in kit form with optional matching case set or fully assembled in case set. We sell tons of these to private investigators!

TG-1, Tone-Grabber Touch Tone Reader Kit.....$99.95
CTG, Case for Tone-Grabber Touch Tone Reader $14.95
TG-1WT, Tone-Grabber, fully assembled with case $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

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Elenco Quad Power Supply Model XP-581

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4 Fully Regulated DC Power Supplies in One Unit

4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

Elenco Power Supply Kit Model XP-720K

- 1.5VDC - 15VDC @ 1A
- --1.5VDC - --15VDC
- 5VDC @ 3A
- 6.3VAC @ 1A & 12.6VAC center tapped @1A

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XP-720 Fully Assembled $85

B&K High Current DC Power Supply

- Variable 3-14VDC
- Thermal Function
- Current Limiting

Model 1686 12A
$169
Model 1688 28A
$249

B&K 13.8V Fixed DC Power Supplies
Model 1680 6A $42
Model 1682 15A $75

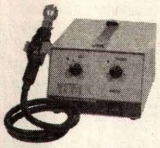
Elenco DC Power Supply Model SPL-603 3A 0-30VDC

The SPL-603 is a solid-state DC power supply providing the exact output voltage no matter what current you use. Output fully protected from overload.

$79.95

Soldering Equipment

Elenco Hot Air SMD Rework Station Model SR-979



The workstation is engineered to meet the needs of today's electronic industry. Wide range of adjustments of air volume and temperature (212°F to 754°F) permits soldering of most surface mount devices. Comes with an A1138 nozzle QFP 28 x 28mm (1.1 x 1.1").

$450

Weller Soldering Station Model WES50

50 watts of controlled power - designed for continuous production soldering.

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Weller Low Cost Soldering Iron Model WLC-100

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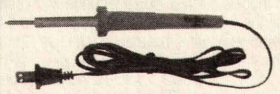
Weller Marksman® 23W Soldering Iron Model SP23



$9.95

Generators & Counters

Elenco Sweep Function Generator w/ built-in frequency counter Model GF-8036

$225

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

10 Function 1.3GHz Universal Counter Elenco Model F-1300

- Frequency .05Hz - 1.3GHz, 3 Ranges
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- Duty Cycle
- Max/Min/AVG with Time
- Stop-watch set .2 sec. to 100 hrs.
- Math Functions
- Timer - 2 sec. to 99 days
- Pulse Width - 0.1ms to 66666.6ms

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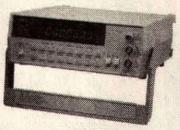
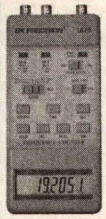


Multifunction Counter

B&K Model 1875

10Hz - 2.5GHz

$189



Ultra sensitive synchronous detector bargraph and RF strength.

3 Channels

Measures Frequency, Period, Data Hold, Relative, Memory (min., max., average). High Sensitivity, Microprocessor Controlled.

Elenco Handheld Universal Counter 1MHz - 2.8GHz Model F-2800

$99

Features 10 digit display, 16 s[illegible]ment and RF signal strength bargraph.

Includes antenna, NiCad battery, and AC adapter.

Elenco RF Generator with Counter

(100kHz - 150kHz) **Model SG-9500**

Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS.

$225

SG-9000 ..... $119.95
(analog, w/o counter)

B&K 20MHz Sweep/Function Generator with Frequency Counter Model 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

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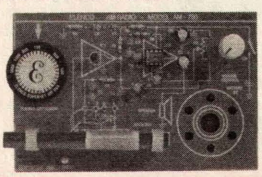

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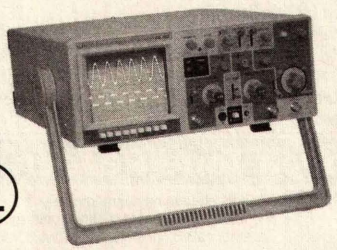

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S-1340	40MHz	Dual Trace	$475
S-1345	40MHz	Delayed Sweep	$569
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Freq. to 4MHz
Inductance
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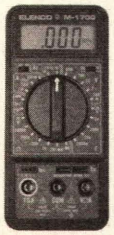
Elenco Model M-1740



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- Resistance .01 to 2000M
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- DC Volts 0 - 20V
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- Signal Output Function
- 3 1/2 Digit Display

Elenco Digital Multimeter Kit Model M-1005K

$19.95

- 18 Ranges
- 3 1/2 Digit LCD
- Transistor Test
- Diode Test
- Training Course

M-1000B
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Many features with Q factor

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Great handheld unit to test PC and Mac monitors. The model 1275 is ideal for the field or the service bench. Small, portable and very effective, the 1275 generates crosshatch, dots, color bars and raster patterns in green, blue, red, black and white.

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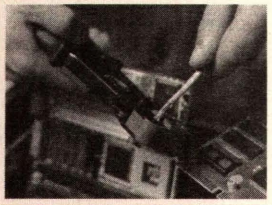

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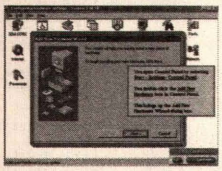

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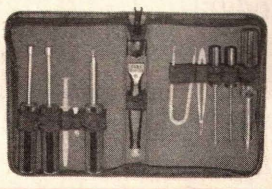

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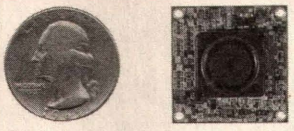

SC-12 - 35mm Lens (1.25"x1.25") $69
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Add $10 for lens • Add $10 for audio

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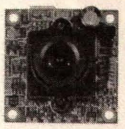

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Add $10 for case

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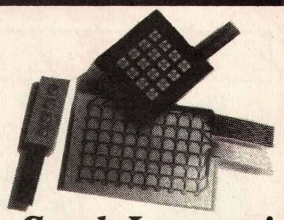

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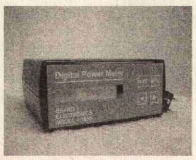

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Model 20- 1850	$249.95	*** CI = Computer Interfacing; includes RS-232 interface, cable and software*
Model 20-1850CI	$299.95	*Maine residents add 5.5% sales tax.*
Model 21-1850CI	$349.95	

Model 4-1850 displays: 117 VAC circuit loads up to 1850 watts Watts, KW-HRS, User Cost, Avg Monthly Cost
Model 20-1850 and 20-1850CI displays: Watt, KW-HRS, User Cost, Avg. Monthly Cost Amps, Volts, Power Factor, Vars, V-A, Peak Watts
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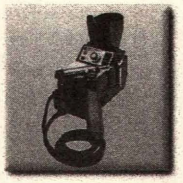

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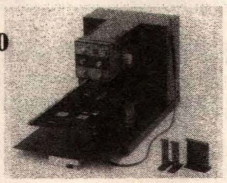

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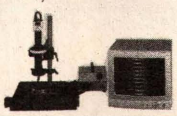

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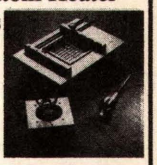

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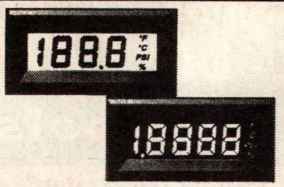

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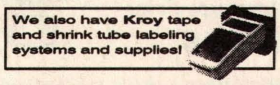

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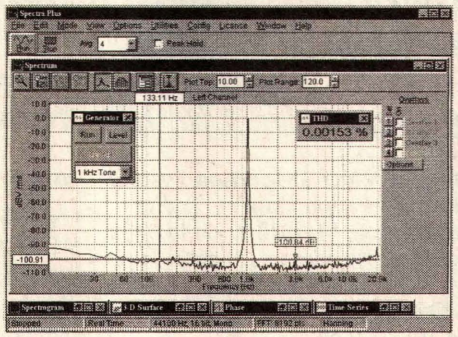

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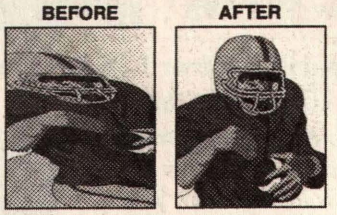

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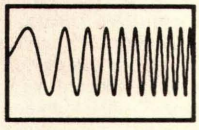
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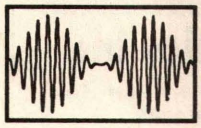
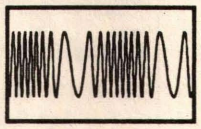

Int/Ext AM, SSB, Dualtone Gen.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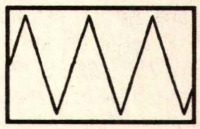
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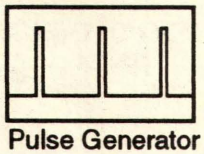
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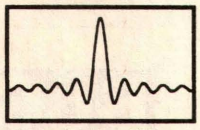
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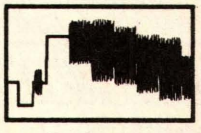
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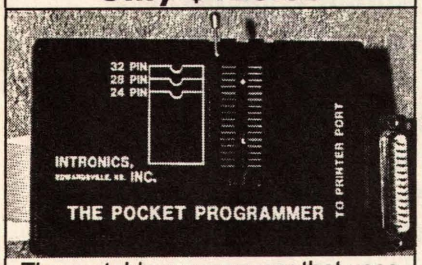

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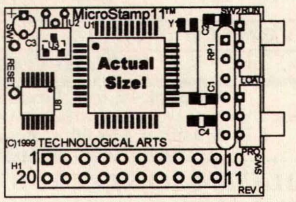

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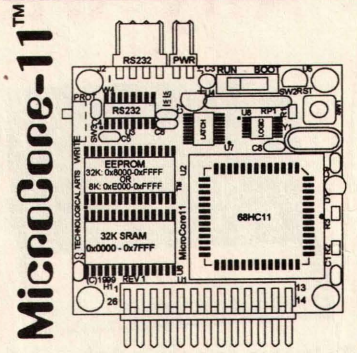

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Continuity Check: with audible signal (signal sounds if resistance is less than 20 ohms. Display reads actual resistance).
Frequency: (1KHz to 300KHz) displays both digital and bar graph reading
Transistor hfe Test: Display shows approximate hfe value based on test condition of 10uA base current and Vce of approx. 3V.
Temperature Test: Measures from 0° to 1832° F (probe supplied!)
Diode Test: Tests if diodes are shorted or open
Input Impedance: 10Mohm (Vdc/Vac): over 100Mohm on 300 mVdc range

Available Late December 1999.

#CSI9903

Specifications

Accuracy	
Vdc:	±1.0% reading +5 ditis
Vac:	±1.5% reading +8 digits
Adc:	±1.2% reading +5 digits
Aac:	±1.5% reading +5 digits
Resistance:	±1.5% reading +5 digits
Frequency:	±3.0% reading +5 digits
Temperature:	±1.0% reading +6 digits

Requires two AAA batteries sold separately.

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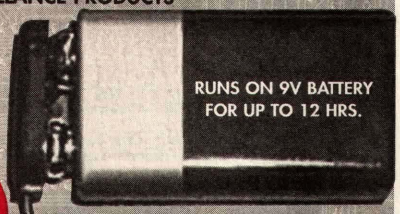

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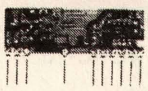

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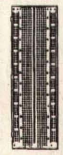

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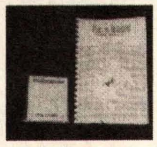
CIRCLE 205 ON FREE INFORMATION CARD

PIC and ATMEL micros in Basic !

New programmer Picstart Replacement with 40pin zif!

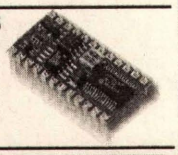
WOW!

PIC n Basic $59.95
Program Pics in Basic! Pic n Basic compiler converts your BASIC program to files that can be used to program the Pic micro. Pic n Basic allows you to use true basic stamp I/II libraries on an ordinary Pic instead of expensive stamps. Pic n Basic is more powerfull and straight forward than anything else like it.

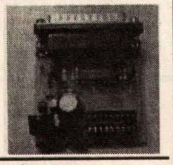


PIC n Basic Pro $199.95

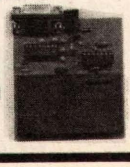
Stamp Replacement $29.95
The Stamp replacement allows you to use an ordinary Pic 16F84 to replace the Basic Stamp II. Pin for Pin Compatible. 4x Times faster using Pic n Basic!



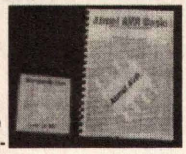
PIC Easy Programer $39.95
The PIC Easy is a low cost Pic Programmer. It will program all the most popular Pic chips See website for list of Pics. Software and instructions included.



ISO Smart Card Programmer $59.95
Now you can read & write to smart cards. Develop your own smart card security systems. Build smart cards using Pics and AVR's or you can adapt ready made smart cards. You can now explore the smart card world! Programmer will read and write to all ISO 7816 compliant cards.



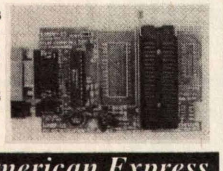
ATMEL AVR Basic Pro $99.00
Program the Powerful ATMEL AVR's in Basic. The AVR's are 25X faster than Pics and now you can program them in Basic. With one AVR you can have up to 32 lines of I/O plus the AVR can handle direct RS-232 serial port with special built-in ports. See website for details on the AVR's.



ATMEL AVR Prototyping Boards $24.95
Get AVR projects up and running in a Flash! Houses the ATMEL AVR and all needed parts for operation plus a large prototyping area for your projects. Comes with a socketed ATMEL AVR AT90S8515!

Need a more powerfull chip?
Try the ATMEL AVR

PIC & AVR Pro Programmer $99.00
The ALLPIC will program almost all Pics without optional adapters! Includes 40 pin zif Socket. Plus it will program Atmel AVR's. Free upgrades for New Chips! See website for list of chips. MLAB compatible. Direct Picstart replacement Includes software and manual.



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Pic n Basic and Pic Easy Programmer Combo #1 ..... $89.95

Pic n Basic with Pic Easy Programmer and stamp replacement Combo #2 ..... $109.95

ATMEL AVR Basic Pro and the ALLPIC & AVR Pro Programmer w/40 pin Zif Combo #3 ..... $179.95

Both Pic and ATMEL Basic with ALLPIC & AVR Pro Programmer w/40 pin zif Combo #4 ..... $229.95

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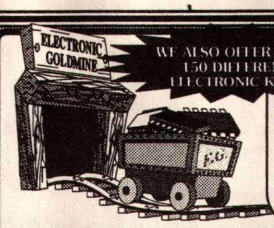
BRAND NEW INTERNET KEYBOARD BY IBM

This smooth action keyboard features a detachable palm rest for greater comfort and various word processor, spreadsheet, and internet "hot keys". Although it is brand new we do not have software to use with the keys so we were not able to see any results from pressing the various hot keys - all regular keys and functions work fine. If you know how to activate these "hot" keys this is a tremendous price! Beige color. Brand new in plastic wrap/bag but no retail packaging and no other info on use of hot keys available. Branded IBM model KB-7993

G1613 $10.00

Internet keyboard as above in Spanish (Beige color)

G1614 $10.49



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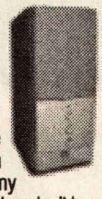
HIGH QUALITY AMPLIFIED MULTI MEDIA SPEAKERS



Made for the biggest name in computers, however the outside cardboard cartons were slightly damaged and the QA inspector would not allow them to be sold. Each set of speakers is perfect in every detail. They feature an AC adapter, cables, power button, volume control, LED on indicator and tone on the master speaker. They don't have any instructions (they aren't needed) and they don't have a slick full color outer sleeve. They are brand new and individually factory wrapped in plastic. We tried a set and were very impressed with the sound quality. Standard computer grey beige case color.

G1607 $9.95 Per set

ELECTRO-MAGNETIC FIELD (EMF) DETECTOR

This is a complete EMF detector utilizing 3 SMD ICs and 10 bright LEDs that indicate relative strength of EMF energy. Operates on one 9V battery (not included). As soon as you press the on/off button, the unit runs a "self-test" by lighting all 10 LEDs then it resets itself and indicates the relative EMF strength by the quantity and color of LEDs that light. Size of unit is about 3 5/16" x 2 3/8". These are brand new and prime, but without the outer plastic case. Full scale is 1 milligauss. We have no data or schematics, but all you need to do is connect a 9V battery and you're in business.

G8317 $3.98 ea.

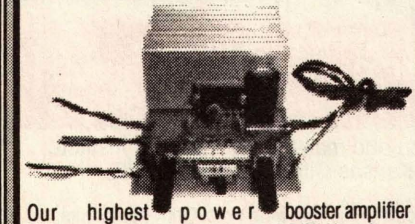
SAFETREE HEAT SENSOR ALARM ORNAMENT

This holiday ornament is also a heat sensitive alarm that you can hang on your Christmas Tree. If there is a fire, the Safetree will emit a VERY LOUD (90 dBA per meter minimum) alarm when it detects a temperature above 122°F. The unit features very sophisticated IC and transistor circuitry driving a loud Piezo Buzzer. This unit operates 24 hours a day for 21 days on one 9-volt battery (not included). The ornament is silver in color and is about 2 1/2" in diameter. Brand new in manufacturer's box, complete with instructions. We are offering this unique holiday item at an extremely low price. Hurry and get yours today!

G9880 ~~$5.95 ea.~~ Sale! $2.95 ea.

Compare at $14.95!

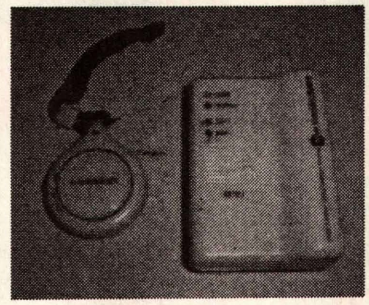
80 WATT CAR STEREO BOOSTER KIT



Our highest power booster amplifier kit is only 4 1/8" L x 2 1/2" W x 1 3/8" H yet it can take a low output car stereo and transform it into a booming powerhouse! Features two crystal clear 40 watt RMS channels for great sounding stereo sound! Operates from as low as 6VDC up to a maximum of 18VDC so it will work in any car. Maximum current draw is 7.5amps and idle current is only 115ma. Power output with typical car input of 14.4VDC is as follows: 40 watt per channel into a 2 Ω speaker load, or 25 watts per channel into a 4 Ω speaker load. Simple to use–just connect the input of the booster kit to your car radio, CD player, etc. output wires and connect any speakers (capable of handling 40 watts) to each output channel. Maximum power occurs at 2 Ω impedance for each set of speakers. Features 2 level controls (one for each channel). Complete with all parts, PC board and instructions. Skill Level 2.

C6817 $39.95

LAPTOP ALARM OR KIDDIE FINDER



Made originally to let a parent know when their child has wandered away, this device would be well suited for a laptop computer alarm. Consists of the small transmitter pendant which requires 12V mini battery (not included) and a clip on receiver unit which requires a 9V battery (not included). On the receiver you can select between a 30ft. or 60ft. range by means of a switch. When the transmitter pendant goes out of range the receiver unit sounds an alarm. Very high tech circuitry. Its up to you to figure out how to mount the pendant to the laptop (epoxy or double stick foam). Great experiment item with hundreds of uses! Brand new bright yellow cases with colorful LED indicators.

G1626 $8.95

BLACKLIGHT TUBE AND 12VDC DRIVER BOARD

Heres the perfect combination! You get one 5 3/4" long blacklight tube and a small driver board which will power the tube for about 1 minute at a time when 12VDC is applied. Simple to use just solder a couple of wires and then connect 12VDC to the circuit board. Light up "glow in the dark" posters, invisible inks minerals etc. With hookup diagrams.

G1658 $2.29

12VDC OPERATED 15KV NEGATIVE ION GENERATOR

Compact negative Ion generator cleans air of impurities and provides a fountain of fresh air. Negative ions are produced during a thunderstorm and these are the same type that this 2 1/4" x 1 5/8" x 7/8" module produces. Operates from 12VDC (can even operate from a 9V battery at slightly reduced output). Simple to use, just connect 12VDC to the red and black power input leads and a tremendous quantity of negative ions will be emitted by the needle assembly shown. These are brand new factory fresh prime units perfect for homes, cars, offices, etc.

G9695E $12.95 ea. • 2/$25.00

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NEW

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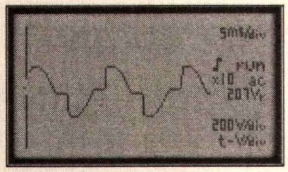
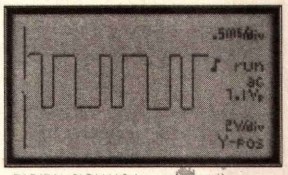
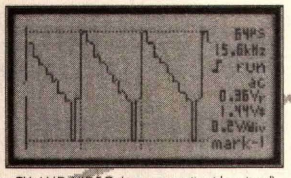
The Velleman **PERSONAL SCOPE™** is a portable fully-functional ***oscilloscope***. At the cost of a good multimeter it gives you the best possible ***value for the money***. The **PERSONAL SCOPE™** provides you with the **high sensitivity** (down to 5mV/div) often missing in higher or similarly priced units. Together with the other scope functions it makes this the ideal tool for students, hobbyists and professionals.



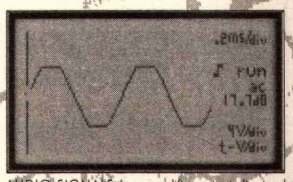
AC MAINS (e.g. phase control)



DIGITAL SIGNALS (e.g. pulse train)

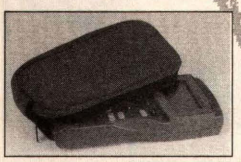


TV AND VIDEO (e.g. composite video signal)



AUDIO SIGNALS (e.g. amplifier output clipping level)

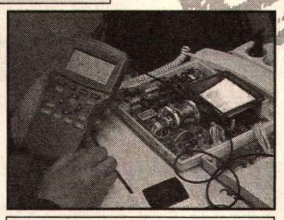
SPECIFICATIONS:
- Maximum sample rate: 5MHz
- Input amplifier bandwidth: 1MHz (-3dB at 1V/div setting) 1Mohm //20pF (standard probe)
- Vertical resolution: 8 bit (6 bit on LCD)
- LCD Graphics: 64 x 128pixels
- dBm measurements: From -73dB tot +40dB (up to 60dB with X10 probe) ±0.5dB
- True rms AC measurement: 0.1mV to 80V (400Vrms with X10 probe) 2.5% accuracy
- Time base: 20s to 2µs / div in 22 steps
- Input sensitivity range: 5mV to 20V/div in 12 steps (up to 200V/div with X10 probe)
- Supply voltage: 9VDC / min 300mA adapter
- Batteries (in option): Alkaline type AA (5 pcs required)
  NiCd/NiMH rechargeable
- Battery life: Up to 20 hours with Alkaline batteries
- Safety: Meets IEC1010-1 600V CATII, pollution degree 1
- Dimensions: 105 x 220 x 35mm (4.13"x7.95"x1.38")
- Weight: 395g (14oz.) (excl. batteries)



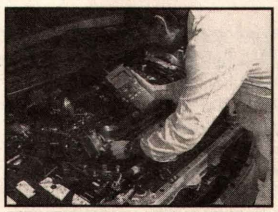
OPTIONS:
- Insulated measurement probe x1 / x10: PROBE60S
- Adaptor for 110VAC: PS905USA

$199.95

Probe not included



SERVICE & DEVELOPMENT



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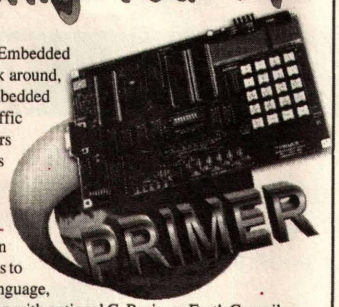

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

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- **Making a Waveform Generator**
- **Constructing a Capacitance Meter**
- **Motor Speed Control Using Back EMF**
- **Interfacing and Controlling Stepper Motors**
- **Scanning Keypads and Writing to LCD/LED Displays**
- **Bus Interfacing an 8255 PPI**
- **Using the Primer as an EPROM Programmer**
- **DTMF Autodialer & Remote Controller (New!)**

The PRIMER is only $119.95 in kit form. The PRIMER Assembled & Tested is $169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade ($49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add $5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad ($29.95) installed. Satisfaction guaranteed.

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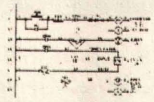
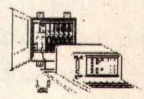
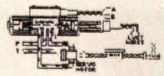


RC-M ONLY $165 RC-M is a 15 hour training course on relay ladder logic systems. Includes a 5-part video and workbook. **Great Value!**

PLC-M ONLY $198 PLC-M is a 32 hour training course on PLC systems. Includes (2) 4-part video's and workbook. **This training is valuable.**





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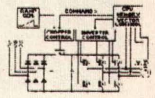

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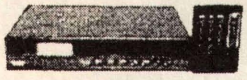

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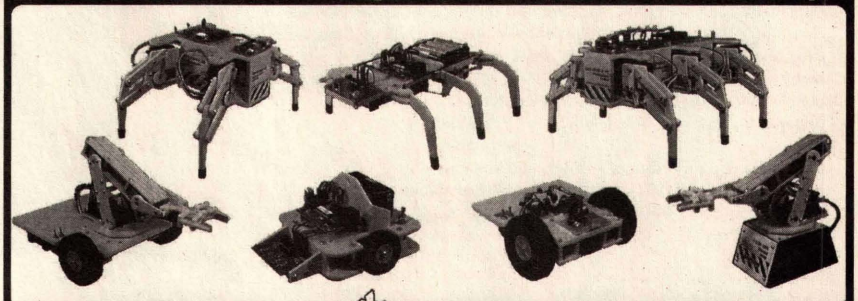

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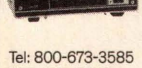

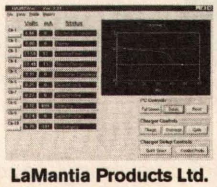

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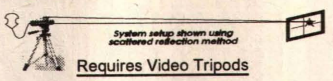

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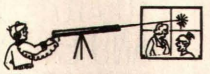

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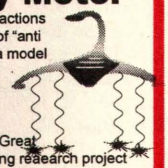

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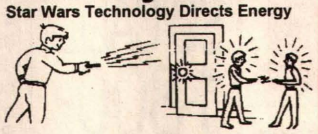

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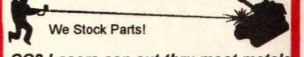

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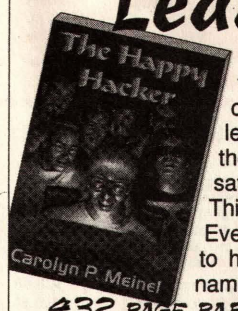

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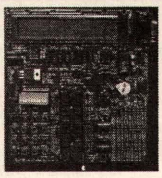

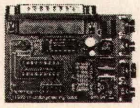

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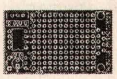

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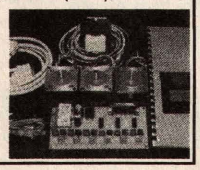

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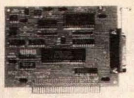

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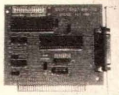

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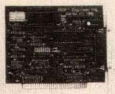

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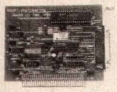

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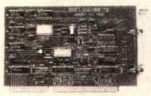

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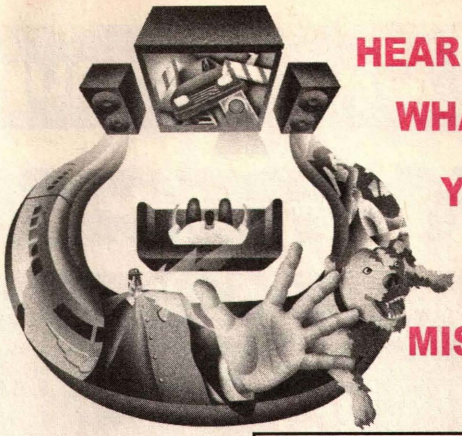

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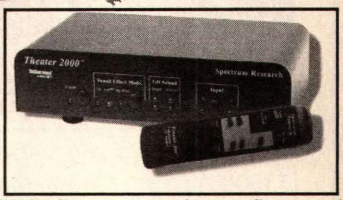

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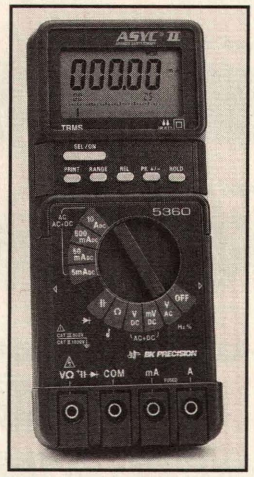

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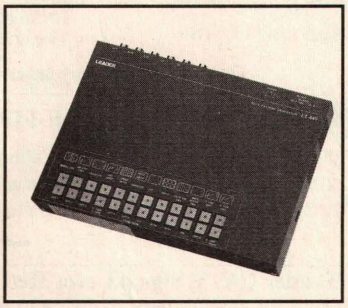

Model	Description	List	Sale
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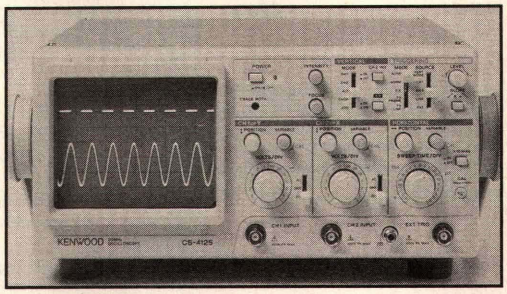

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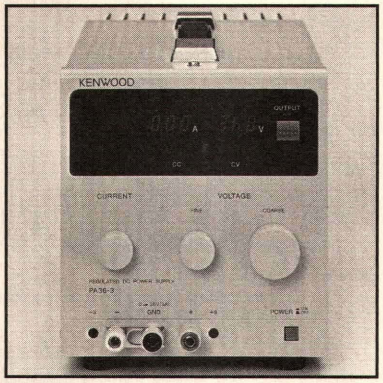

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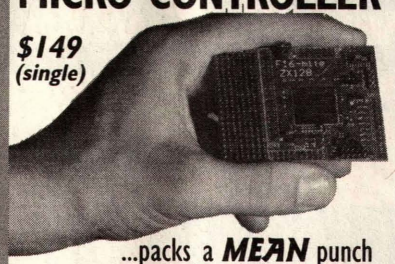

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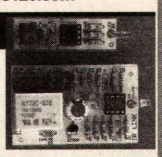

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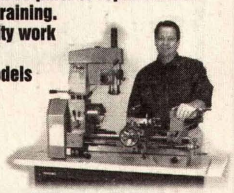

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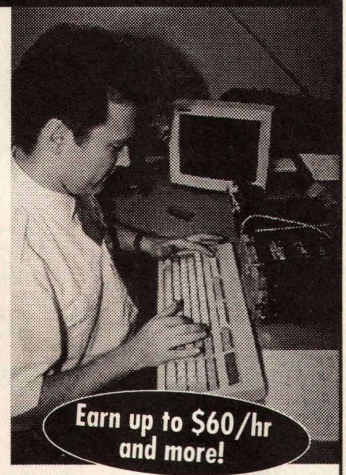

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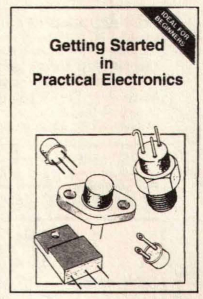

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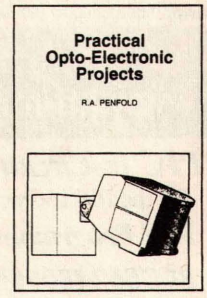

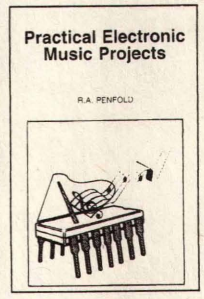

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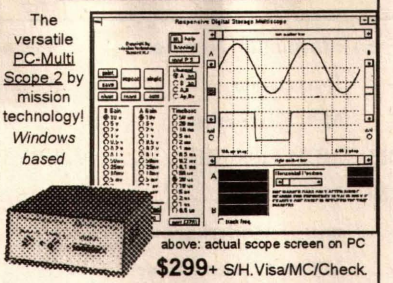

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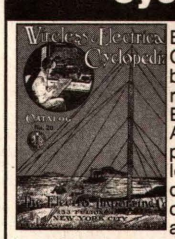

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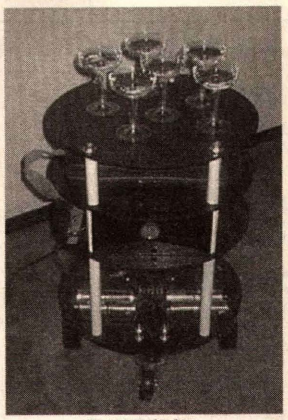

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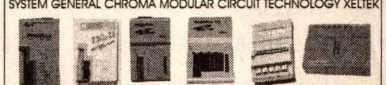

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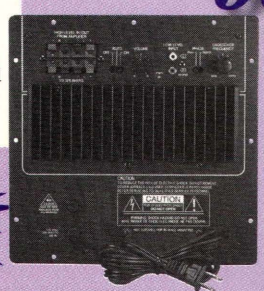

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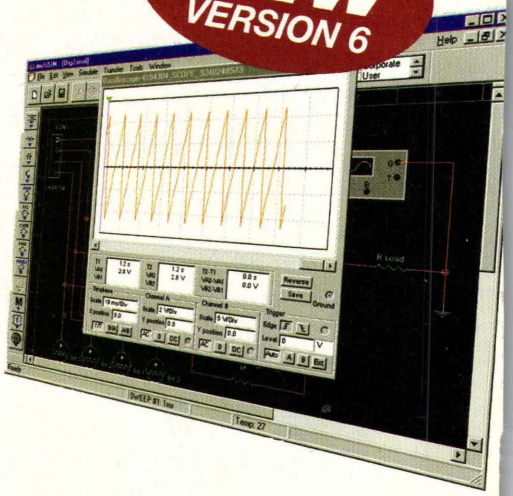

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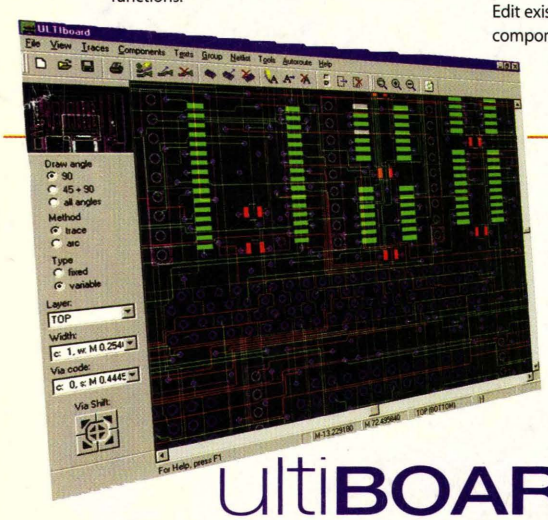

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